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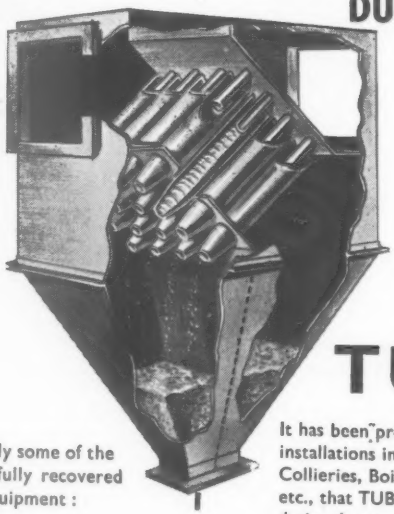

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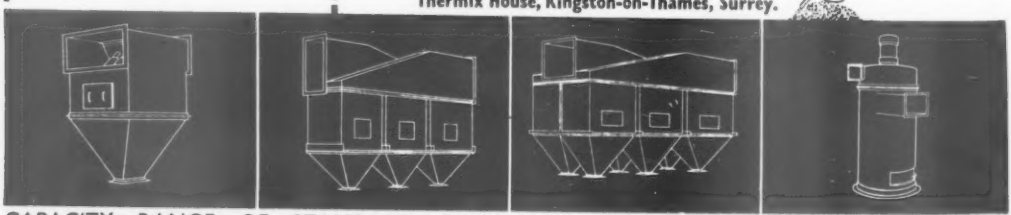

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Ventilation and Dust Control

The recent Harrogate Conference organized by the British Cast Iron Research Association on "Foundry Ventilation and Dust Control" attracted a record attendance—of the order of 280. The major interest in the background was the coming into force of the new Regulations on January 1 next year. It was obvious that the iron-foundry industry has given very serious attention to the problems involved. Not only have the stand- and swing-grinding machines been provided with gadgets for the elimination of dust at the source, but several types of hand tools have been similarly treated. One which specially appealed to us was a de-coring bar invented by Mr. W. H. White, of the Research Association. Here, a water spray issuing from a collar surrounding the bar, damps the sand without causing mud. For knock-out grids, good practice is tending towards the side evacuation of dust rather than suction downwards.

We were not so impressed with the conclusions drawn by two members of the staff of the Building Research Centre. We gathered that they advocated low buildings for foundries as being easy to ventilate. Conversely, we advocate high buildings where experience has shown that no dust problem exists for most types of castings manufactured. It would appear that there is a tendency to confuse steam with dust. It is good to see that attention is being given to the theory of ventilation of workshops, as we know of some naturally-ventilated foundries, which carry a much cleaner atmosphere than others, where extensive mechanical air evacuation has been installed. By paying attention to eliminating dust at its point of creation, the problem of general ventilation is much simplified.

It was right and proper that Sir George Barnett, HM Chief Inspector of Factories, should have been asked to give the opening address, as he is cognisant and appreciative of the aspirations of both the trade unions and the employers. He is likewise well aware of the almost insoluble problems of the owners of small foundries which arise in their attempts to comply with all the provisions of the Regulations. They do not always own their premises and if extensions are called for to improve matters, then they are consequentially frustrated. Fortunately, they work slowly as compared with the large mechanized shops and the production of dust is irregular and therefore less harmful. Out of the plethora of recommendations and improved methods, will emerge the essentials for the small jobbing foundries, and the implementation of these will enable them to continue giving the all-important services to industry in general.

Worshipful Company of Founders

Last week a party of the Worshipful Company of Founders made a visit to the Department of Metallurgy in the University of Cambridge and to steel and iron foundries in Letchworth and Braintree. On Tuesday, May 3, the party visited K. & L. Steelfounders & Engineers, Limited, where they inspected the manufacture of mobile cranes at all stages and in all sizes. After an excellent luncheon presided over by the managing director, Mr. F. W. Rowe, the party spent the afternoon in the steel foundry, where they were impressed by the lightness and cleanliness of the shops and particularly by a new foundry of striking and unusual design with a minimum of structural steelwork. This will tend to eliminate dust deposits and make for better working conditions. Every effort is made to safeguard the health of the employees and the washing and canteen facilities are second to none. After tea the party proceeded to Cambridge where dinner was taken at the University Arms Hotel.

Cambridge Laboratories

On Wednesday, May 4, the party visited the Cavendish Laboratory of the Department of Physics, Cambridge University, where they were privileged to see the museum with exhibits of the work of Clerk-Maxwell, Rayleigh, Thomson, Rutherford and Aston. It was not possible to visit the whole of the very large Department but Dr. Taylor gave an interesting talk on the researches being carried out on the crystallography of metals and alloys and Dr. Horne demonstrated the use of the electron microscope in studying the internal structure of metals. (This microscope is capable of 60,000 magnifications.) Coffee was taken in the Goldsmiths Laboratory of the Department of Metallurgy, after which the party toured the Department, laboratories and inspected a number of researches from the 30 in progress. The liverymen were greatly impressed with the quality of the work being carried out and its value to the foundry and metallurgical industries. In addition to research for Government Departments and large industrial undertakings, researches are also sponsored here by the British Steel Castings Research Association.

Luncheon was taken in Dr. Eden's room in Trinity Hall. Dr. Eden was a noted Master and benefactor of the College which is over 600 years old and was founded for the study of law, although all faculties are now represented in its Fellowship. After luncheon, Professor Wesley Austin and his colleagues took the party on a tour of the Backs. In King's College Chapel a rehearsal by the University Musical Society was in progress and the members rested before continuing their tour. Following a walk through Queen's College, Clare Gardens and Trinity College the party passed through the cloisters of St. John's over the Bridge of Sighs into the College itself where they were shown the famous Combination Room, and afterwards into the Old Schools. They were entertained to tea in the University Common Room, one of the finest rooms in Cambridge and a club for the University teaching officers.

In the evening the liverymen were entertained to a sherry party in the Wordsworth Room of St. John's College by the Master, Mr. Wordie, and an old Johnonian of the Livery, Mr. A. P. L. Blaxter. Dinner was taken in the gallery above the hall in Christ's College by kind permission of the Master and the Bursar, Dr. Prest.

East Anglian Works

On Thursday, the party travelled by coach to Braintree to visit the steel and iron foundries and engineering shops of Lake & Elliot, Limited. Here they were shown a small intensively mechanized iron foundry occupying what had previously been the boiler house of the power station and the steel and iron foundries where carbon, alloy steels, and high-duty irons are made. The visitors were interested in the fume extraction on the arc furnaces and the extensive range of pressure-resisting castings made. The iron foundry makes high-duty irons chiefly for the automobile industry. Luncheon was taken in the canteen under the chairmanship of the managing director, Mr. C. H. Kain.

After luncheon, the party were privileged to visit Warner & Sons, Limited, New Mills, Braintree. Warners are the inheritors of the weaving traditions of Spitalfields and specialize in the weaving of fine silks and tapestries for the most exclusive furnishings. Cotton, wool and artificial fibres are also woven on power looms, but the firm continues the quality traditions inherited from the Huguenots and the Spitalfields tradition in unique designs on hand looms. Members saw pattern books from the early 18th century in which the colours are still perfect and which would be acceptable in any modern building. After tea the visitors returned to London.

Dinner

NATIONAL SOCIETY OF MASTER PATTERNMAKERS

The first annual dinner of the National Society of Master Patternmakers was held last Friday, Mr. B. Levy presiding, at the Café Royal. About 80 members and guests were present. The toast of the new Society was proposed by Mr. V. C. Faulkner who tried to compare the function with the first held many hundred of years ago by the Worshipful Company of Founders. In his reply Mr. Levy announced that he was presenting for annual competition a silver medal. Mr. L. Brown proposed "the guests," and Mr. John Bell, the president of the Institute of British Foundrymen, included in his reply the following definition of a patternmaker.

"A patternmaker is an exalted craftsman, the greatest common denominator as well as the least common multiple of all industrial production. A patternmaker must have the creative conception of a draughtsman designer, the practical ability of a moulder—the precise skill of a machinist, the analytical judgment of a metallurgist and the specific exactness of a mathematician. He must create a plan, or design, with vision and ingenuity and build the idea from trade to trade with practical knowledge: thinking and forming inside and out with length, breadth and thickness—adjusting accurately all values and dimensions and producing with dextrous finality any conceivable form to be cast in metal. The products of the patternmaker's skill are truly surrounded by an aura of greatness which dignifies his right to assume a place of confidence, trust, and honour in all industrial advance and national progress" (Edward Leslie).

After dinner there was dancing to the music of Sydney Jerome's orchestra and the company was entertained by Ravic and Babs, acrobatic skaters, and Spence and Davies, musical clowns. The function was very efficiently organized by Mr. G. Judd, the secretary.

Carbon-dioxide Process*

By D. V. Atterton, M.A., Ph.D.

(*Continued from page* 482)

[The Author continues his remarks under the sub-heading "Hardened Strength" as follow:]

Optimum additions of binder from the point of view of strength have been determined simply by investigating the variation in strength with binder content when gassing cores for a constant time. This is illustrated by Fig. 5, which shows such curves for a fine three-medium and a coarse sand. It should be pointed out that if gassing was further continued, then the curves would not fall off at the higher binder percentages.

A large number of sands have been investigated in this way and it has been found possible to discover a moderately good relation between optimum binder contents and the AFS fineness number of the sand (Fig. 6); since the AFS fineness number is understandably not used to any great extent in the foundry industry, several well-known sands have been marked on this curve.

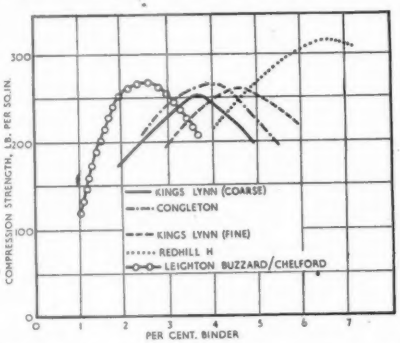


FIG. 5.—*Variation in compression strength of various sands with binder content, for constant gassing time.*

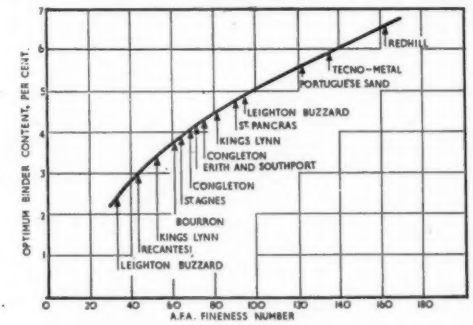


FIG. 6.—*Relation between optimum binder content for maximum strength and the AFS fineness number of the sand.*

Thus, it may be seen that the generally-used foundry sands may be employed satisfactorily for the process. It is perhaps advisable to consider at this stage some of the other sand properties, in addition to strength, that are of importance in a mould or core sand.

Other Properties

The "green" strength of sands bonded with binders intended for the CO_2 process are very low, about ½ to 1 lb. per sq. in., depending upon the milling time and type of mixer. However, green strength is of little or no importance when the core or mould is hardened in the box or with the pattern in position, respectively. The green strength of the proprietary high green-strength binder gives approximately 2½ to 3 lb. per sq. in. and is, of course, intended for use when stripping is carried out prior to hardening of CO_2.

The flowability of a large range of sand-mixes bonded with the proprietary binder is about 80 as determined by the standard deformation-test. The more informative shatter-index figure shows the sand to compare very favourably with highly-flowable conventional core-sands. Due to both the low green strength and high flowability, flat ramming is the best method to ensure good packing, and it does not take long to acquire a technique for handling this unusual sand.

The permeability is significantly higher compared with the same sand bonded with conventional binders. In Fig. 7 the variation of permeability with percentage of binder is shown for a typical core sand. The same sand, when bonded with an appropriate linseed-oil-base binder, has a green permeability of 92 and a dry permeability of 135, whereas the value with the optimum CO_2 binder addition, *viz.*, 4 per cent., is 172. As mentioned earlier, this high permeability, coupled with the low volatile content of the sand, certainly reduces the danger of blowing.

METHOD OF INTRODUCING THE GAS

Requirements

There is little doubt that the techniques employed for introducing the gas into the compacted sand will be the field of greatest development with the

* Paper presented to the Birmingham branch of the Institute of British Foundrymen, Mr. J. L. Francis presiding.

Carbon-dioxide Process

process in the future. The desirable features of any such technique are to get:

(i) the gas into the sand in the minimum of time;

(ii) into all parts of the sand so that they are equally and effectively hardened;

(iii) the minimum of consumption of gas;

(iv) the minimum amount of manual work, and

(v) no bottleneck on mould or core-making machines.

The quantity of gas required to obtain a good initial set of the sand with say a 4 per cent. addition of the proprietary binder is approximately 0.2

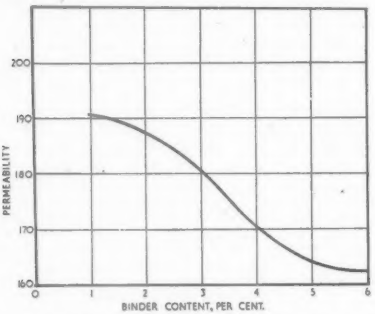


FIG. 7.—*Variation of permeability with binder content for a Congleton sand.*

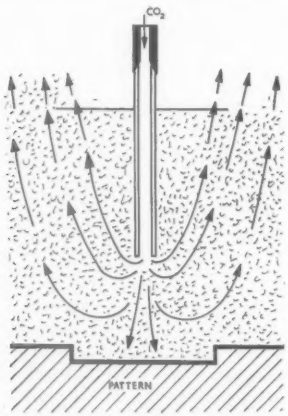


FIG. 8.—*Hardening of sands; a simple method for hardening cores and moulds.*

to 0.3 per cent. of the weight of sand treated; any quantity of gas used above this amount is mainly wasted. Thus, due to the rapidity of the initial reaction, the gas should be permeated as far as possible throughout the compacted sand-mass in the shortest possible time.

An obvious elementary method of introducing the gas is shown in Fig. 8. A tube is inserted into the sand and passage of gas down the tube leads to rapid hardening in the region of the tube opening; the pressure of the carbon dioxide then forces the gas outwards through the sand causing further hardening until the gas escapes into the atmosphere. A volume of sand of radius of about 3 to 4 in. around the tube is sufficiently hardened in about 15 to 30 seconds. Passage of gas for any longer period of time naturally increases slightly the volume of hardened sand and also the actual strength (Fig. 1) but in general is mainly wasted due to escape of gas to atmosphere through the already hardened sand-mass. Similar comments also apply to increase in the pressure of gas application; although higher pressure slightly increases

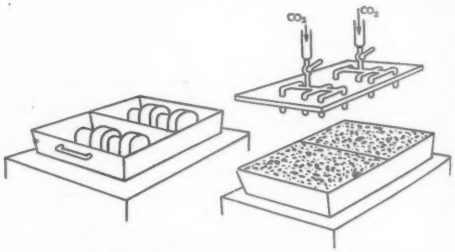


FIG. 9.—*Semi-mechanized, tube method for hardening book-type moulds.*

the volume of hardened sand, it also increases the rate of escape of gas to the atmosphere, and experience to date has shown the optimum gas-pressure for efficiency and economic hardening is just about 15 to 20 lb. per sq. in. as registered on the outlet valve.

Use of Tubes

Thus cores and moulds can be hardened by introducing gas by means of tubes immersed into the sand at 4 to 6 in. intervals. However, it should be emphasized that this method is not satisfactory for the obvious reasons that it involves a considerable amount of time and labour and the technique is extremely difficult to mechanize. Nevertheless, some methods have been developed and the tube technique has been employed for the production of large moulds and cores where the amount of time involved in gassing is comparatively unimportant compared with the total time of making the core or mould. Fig. 9 shows a semi-mechanized tube method that has been employed for the production of book moulds. A heavily-tapered moulding box is placed over two half metal patterns; the sand is dumped in from an overhead hopper, jolted and then strickled off. Suspended on a pulley above the box is a flat metal plate, containing a series of tubes which follow the contour of the patterns and are spaced at about 4 in. intervals. The plate is lowered on to the strickled surface so that the tubes are embedded in the sand. By means of two handle-type taps, the operator ap-

plies carbon dioxide for about 12 to 15 seconds. The box is then inverted and the two half patterns are tipped out. The total time for this whole operation is about 50 to 70 seconds.

Modification of Corebox Design

The tube method has nevertheless frequently given variable and unsatisfactory results apart from being comparatively cumbersome. This is particularly true in the case of cores as is illustrated by the following practical examples. Fig. 10 shows the corebox used for the production of a pinion core. Using a tube and blowing down the centre for as long as 3 to 4 mins. led to a partial hardening of the bulk of the core, but the teeth and nose were still very friable. When such a result has been obtained in practice it has tended to detract from the value and efficiency of the process, but it should

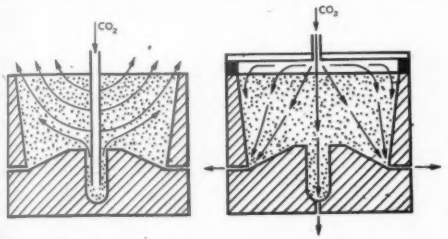


FIG. 10.—*(a) (left) Unsatisfactory method of hardening a pinion core; and (b) satisfactory method of hardening for the same job.*

be emphasized that this is only due to faulty gas-application. As the gas passes out of the tube it permeates through the sand and finds a path of least resistance to the atmosphere; due to the impermeable nature of the core box, air pockets are formed at sharp re-entrants such as at the teeth and in the nose. It naturally takes a long time for this air to be displaced and, although hardening might eventually take place, the method would be most wasteful both in time and in carbon dioxide.

By cutting vents on the loose pieces by every tooth and through the nose, a clear path of gas through all parts of the sand can be obtained. In addition, the gas application may be considerably simplified by covering the print face with either a rubber cap or a board having a rubber seal. With this set up, gas blows through all parts of the core, displacing air in the pore spaces. In practice, the time of gassing to obtain a satisfactory uniformly-hard core was reduced to less than 30 sec.

Thus, it must be emphasized that although satisfactory cores can be obtained by inserting tubes at a variety of angles into all parts of the core (a laborious and time-consuming process) a far more rapid and efficient method is obtained by modifying slightly the design of the corebox so that a free flow of gas is possible to all parts of the core.

Importance of Vents

Friable cores may also result when, applying the gas through a rubber diaphragm over the print face, there is a path of least resistance to the atmosphere in one specific direction. This type of difficulty occurs particularly with split coreboxes when there is a badly fitting parting-line, or with the corebox designed for use on core blowers, where the venting requirements for satisfactory blowing may often be diametrically opposed to those necessary for passing the carbon dioxide through the core efficiently and with the minimum of wastage. During the production of a cylindrical core in a closed-end split box, considerable difficulty was experienced in obtaining a hard, non-friable nose on the core; in the light of earlier work, it was realized that the rate of escape of gas through the parting line was so rapid that there was very little flow of gas through the nose to displace the air present in the pores. A good-quality core was produced by sealing the parting line on the sides of the core-

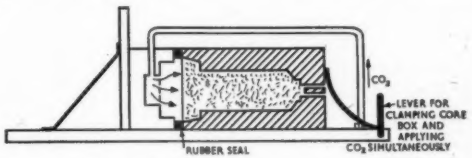


FIG. 11.—*Mechanized method of applying CO_2 to cores.*

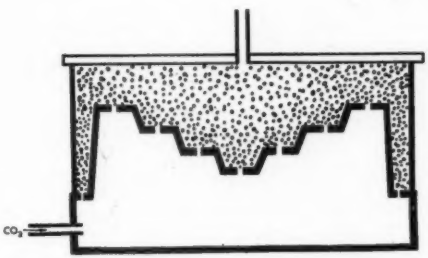
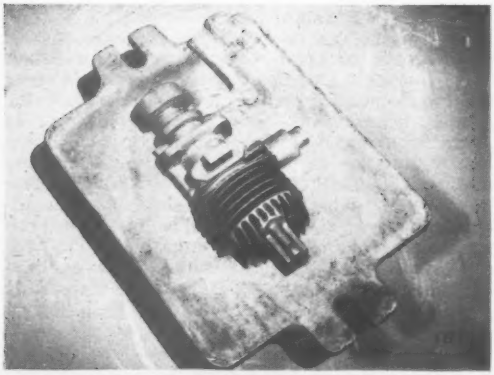


FIG. 12.—*Use of a hollow, metal pattern for the rapid production of moulds.*

box and by making a small vent in the box at the nose of the core.

A somewhat similar difficulty arose in the production of another cylindrical core to which was attached a mushroom-shaped print; this core was produced on a core blower and there were two vents at the nose of the core and four in the print. Application of gas by means of a cover over the print produced a core after two minutes gassing which still had a green nose. This was due to excessive loss of gas through the corebox vents in the mushroom-shaped print so that the gas never entered the body of the core. Sealing of these vents, so that gas now passed straight through the core and out through the vents in the nose led to the production of a hard core in about 30 sec. blowing time.

Thus to summarize, when producing cores by



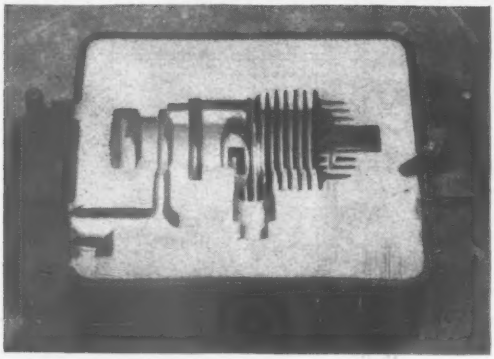


FIG. 13.—*Production of the mould for an air-cooled cylinder:*

(*a*) *The pattern.*

(*b*) *The facing of CO_2-hardening sand which is then followed up with a low-moisture-content green-sand backing.*

(*c*) *Mould after stripping the pattern prior to CO_2 application.*

(*d*) *Application of gas down the sprue to the two half-moulds.*

(*e*) *Final air-cooled cylinder casting.*

the carbon-dioxide process, due consideration must be given to the following points:—

(1) Where there are re-entrant angles, closed ends, etc., in the box, vents must be introduced so that there is a clear path of gas through the whole body of the core.

(2) When there are paths for the gas in certain specific directions, so that gas channeling occurs—as with the corebox vents in the last example—then every effort must be made to remedy this.

(3) The gas is best applied by a gasket or rubber cover fitting over the print face with a moderately gas-tight seal—this method can readily lend itself to mechanization.

Mechanization of Gas Application

Mechanization of the gas application is most desirable, particularly for small cores, as otherwise several of the advantages of the process may be nullified; thus, if the time of gassing is large compared with the total time of producing the core, then there will obviously be a marked reduction in output of cores from a core-making machine. This is particularly true of core blowing where a high output of green cores is normally possible and therefore it is essential that any method of gas application occupies only the minimum of time and labour.

A variety of methods of mechanized gas-application can be readily visualized and a simple prototype example is shown in Fig. 11. While the core is being gassed, the next may be blown and a continuous cycle established. This set-up on a preliminary run and without any refinements has led to a reduction in the number of cores obtained from the core blower of only about 10 to 15 per cent. Considering that the cores were ready for use and that no carriers, etc., were required, this figure was considered very satisfactory.

This simple prototype can naturally be improved upon and work is in hand to develop:—

(*a*) blowing of the core followed by immediate application of carbon dioxide, and (*b*) blowing of the core so that carbon dioxide is applied simultaneously with the admission of the sand into the corebox.

Moulds

A method of partially mechanizing the tube-method is described earlier in the Paper, and similar methods using grid systems of tubes have been successfully employed for the production of large moulds. Hardening of moulds may also be achieved in a similar way to cores by covering the box with hood or cover and introducing the gas through the sand face remote from the pattern surface. Alternatively, when a large quantity of moulds are required for repetition casting, it may be worthwhile to utilize a hollow pattern and inject the gas through the moulds by means of vents on the pattern face (Fig. 12).

However, perhaps the most suitable technique for moulds is to utilize a CO_2 setting-binder which imparts good green strength to the sand. Moulds may then be satisfactorily stripped green and hardened in a variety of simple ways; thus after stripping, the mould may be covered with a board and gas then injected directly into the mould cavity. An illustration of another technique for hardening where the high green-strength binder is employed is shown in Fig. 13.

Apart from enabling more rapid production, this high green-strength binder eases the stripping of the mould from the pattern. When both cores and moulds are hardened in the box or with the pattern in position respectively, stripping is certainly more difficult than with green sand. However, the ease of stripping can be considerably assisted if the following precautions are taken:—

(1) Fill up any undercuts or dents, etc., in the box with plastic wood, etc.; this will prevent the sand keying into these imperfections which would make stripping difficult, or damage the core or mould. Alternatively, the pattern can be partially stripped green, and then the box returned to its normal position before hardening; this technique breaks any undercuts and assists stripping after hardening.

(2) The box should be rapped prior to hardening, in the same manner as with green sand. If this practice be adopted then difficulty is not experienced with the majority of cores and moulds, unless there be a very deep draw.

(3) All boxes for future use on the process should preferably be collapsible and patterns should have a good taper so that stripping is facilitated.

Surface Finish and Collapsibility

The quality of the surface finish and the degree of collapsibility obtained with the carbon-dioxide process sands shows considerable variation, depending upon the metal being used, the section thickness, etc. On some occasions both the finish and collapsibility have been considerably better than normal practice, and in other cases inferior. In this section an attempt is made to rationalize and explain these results and to discuss techniques for obtaining a high-quality surface-finish and satisfactory collapsibility for all metals.

When the sands bonded with waterglass-base

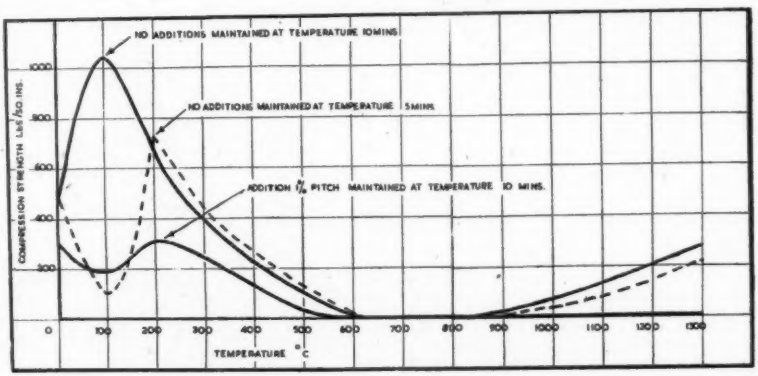


FIG. 14.—*Variation in strength of CO_2-bonded sands with temperature.*

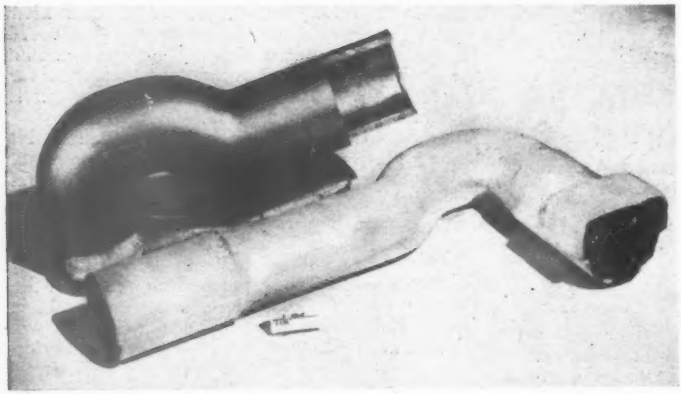


FIG. 15.—*Light-alloy die-casting, produced with a CO_2-bonded core.*

binders are heated, several complex reactions and changes occur (Fig. 14). The strength of the sand varies markedly; on heating to about 100 to 200 deg. C. there is initially quite a marked decrease in strength followed by a very sharp increase leading to compressive strengths of the order of 1,200 lb. per sq. in. Further heating above 200 deg. C. leads to a drop in strength and the sand is completely collapsible by about 500 to 600 deg. C. and remains so until heated to about 900 deg. C. when the strength gradually begins to climb due to a partial sintering of the binder. As will be shown later, this increase in strength after 900 deg. C. can be markedly reduced by making small additions to the sand. However, from the point of view of collapsibility, it is important to emphasize that it is the behaviour of the sand at comparatively low temperatures which probably plays the predominant part.

Thus with light-alloy castings, the temperatures generally reached by the moulds and cores are such that the majority of the sand is heated only to the region where the sand strength is low and consequently the collapsibility is good. However, in a few cases, comparatively poor collapsibility has been obtained and this no doubt occurs where the section thickness of metal to the section of sand is such that the sand temperature attained corresponds to the maximum on the strength/temperature curve.

With steel, although the facing layers are heated to high temperatures, the bulk of a core probably only reaches temperatures of the order of 500 to 1,000 deg. C. where the collapsibility of CO_2 setting-sands is excellent.

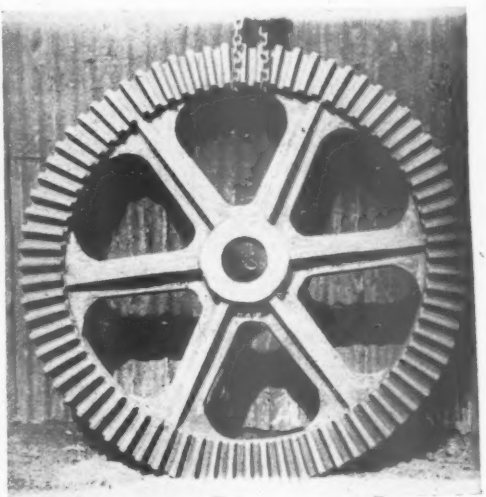
On iron castings, the collapsibility can vary from poor to good, depending on the relative section-thickness of metal and sand; this variation is once again simply a reflection of the strength/temperature curve for the sand.

However, it is considered that the ultimate solution lies in developing suitable additions which will alter the form of the relation between sand strength and temperature. It can be seen from Fig. 14 that pelletted-pitch additions eliminate the strength increase above about 900 deg. C. and additions of this material do considerably assist collapsibility in many cases. There appears to be an optimum addition somewhere in the region of 1 to 2 per cent.; with too-high additions, the pelletted pitch tends to impair collapsibility in the centre of large block-cores where the pitch is not burnt out. Other additions to aid collapsibility that have given satisfactory results in practice are coal-dust, fine charcoal, asphalt and also high-quality fluorspar.

The surface finish of light-alloy castings prepared in carbon-dioxide process sand is directly comparable to that obtained with conventional oil or resin binders; a typical aluminium casting is shown in Fig. 15.

With iron castings of heavy section-thickness, the surface finish is generally poor unless no coatings or additions are applied to the sands, severe metal-penetration occurring in some cases. However, it should be remembered that a good surface-finish on iron is generally only obtained when volatile-carbonaceous additions are made to the sand, either in the sand mix or as a coating. When such additions are made to carbon-dioxide process sands, there is a marked improvement in surface finish. The carbonaceous additions used to assist collapsibility are all suitable for improving the

FIG. 16.—*Cast-iron crown-wheel, finished weight 18 cwt.*



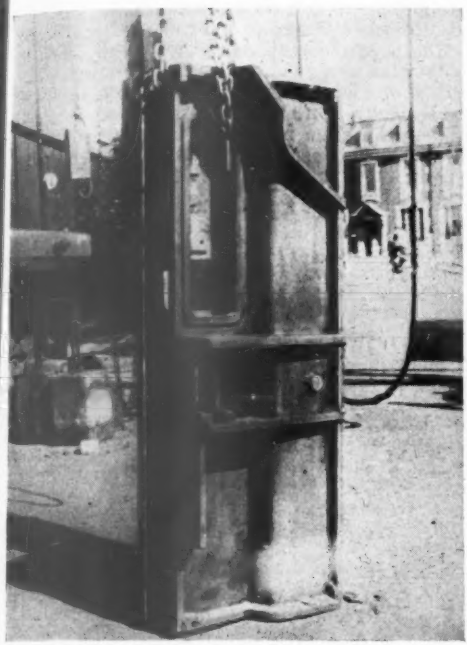


FIG. 17.—*Cast-iron pedestal for a pie-making machine—machined weight* 18 *cwt.*

surface finish which improves steadily with increase in the amount of the addition and, weight for weight, pelletted pitch is probably the best. Several typical iron castings are shown in Figs. 16 and 17. Fig. 13 also illustrates the finish obtained on a sand containing no addition, but treated with a graphite-based dressing.

With steel castings, the surface finish is much of an enigma. The surface finish is generally better than normal practice and this is particularly true of heavy sections; whereas normally with steel castings, penetration and burn-on increase with increasing section-thickness even when refractory paints are used, the opposite is true of the carbon-dioxide process. The good surface obtained in practice with no addition or coating applied to the sand is illustrated by the castings in Fig. 18.

FIG. 18.—*Spindle and coupling produced in steel. The finished weights of the spindle and coupling are* 9 *and* 4 *cwt. respectively.*

Acknowledgments

The Author would like to acknowledge the considerable assistance of various foundrymen and of his colleagues who are responsible for much of the information presented in the Paper. In particular, he would like to acknowledge the great pioneer work on the process of Mr. Ivor Rees, of Glanmor Foundry Company, Limited, who has also so generously assisted in preparing the Paper; also he would like to thank his colleague, Mr. F. Pursall, who has carried out the extensive investigation of sands and of sand properties reported, and Mr. D. H. Snelson, who has been actively engaged on the application of the process to coremaking machines.

Finally, he extends his grateful thanks to the many foundries who have kindly assisted and who have given permission for the reproduction of photographs of their production castings; in particular, thanks are extended to: Western Foundries, Limited, Villiers Engineering Company, Limited, Bromsgrove Castings Company, Limited, Samuel Osborn Company, Limited, J. Stone & Company, Limited, Thomas & Clement, Limited, and once again Glanmor Foundry Company, Limited. The Author would also like to acknowledge gratefully the continued interest and encouragement of the directors of Foundry Services, Limited, and for their permission to publish the information.

DISCUSSION

The CHAIRMAN (Mr. J. L. Francis) thanked Dr. Atterton for a most interesting and well-explained lecture which showed, in principle, the extreme simplicity of the CO_2 Process. The main problem appeared to be the application and mechanization of the process to individual foundry conditions.

MR. SHOTTON said it was a great pleasure to propose the vote of thanks. Dr. Atterton had given an excellent lecture and it would not have been possible

to have it explained in a more interesting and unbiased manner. He referred to the mention of the addition of some carbonaceous material, mainly, he gathered, for stripping purposes. Could the lecturer say whether there was any addition made from the point of view of acceleration of the hardening? Was any accelerator used? Then referring to breakdown he asked whether in normal high-temperature moulds and thick section castings, the greater amount of heat applied to the core or mould facilitated the breakdown. As to the various sands which were used and the desirability of the sand being free from clay, could the lecturer say anything about the selection of such a sand and the limiting factor as far as clay was concerned; he mentioned particularly Congleton sand in this context.

MR. HIRD thought this process was the greatest advance since the invention of the cupola. He felt that foundrymen had to alter their outlook in view of the process which had been so ably described by Dr. Atterton. There was much in it for everyone and he was pleased that Birmingham was the first branch of the Institute to discuss this process.

Purpose of Additives

DR. ATTERTON afterwards thanked Mr. Shotton and Mr. Hird for their very kind remarks, and said in reply to Mr. Shotton that carbonaceous additions such as pelleted pitch, asphalt, coal-dust and also wood-flour (this last material was not recommended as it caused friability of cores and moulds) were being used but these were mainly to increase the collapsibility of the cores or moulds, coupled with an improved strip in the case of iron and steel. Additions of fluorspar (as mentioned in a recent letter to the FOUNDRY TRADE JOURNAL) were being investigated and so far, results were quite promising. This type of material would be quite useful from the point of view of lack of gas and fume evolved, as compared with carbonaceous materials. With steel, a reversal of usual casting finish was obtained inasmuch as with thin sections the strip was only equivalent to normal sand practice, whereas, with heavy sections, the strip was excellent. Some of the sands successfully used did contain quite high clay-contents; this clay figure was determined in the normal way and did, of course, cover fines in addition to clay. So far a very wide range of sands had been used but the main point to emphasize was that active clays were deleterious to strength.

MR. HIRD said one seemed to have to approach the CO_2 Process from a different angle from ordinary moulding.

MR. PERRY said that with the air-cooled cylinder shown mention was made of backing up with green-sand. How did one separate this from the CO_2 sand, and what was the best material to back up with?

DR. ATTERTON advised that one should back up with a low-moisture green-sand, say 3 to 4 per cent. As mentioned earlier, it was not possible at this stage to give any definite recommendations on sand reclamation. So far, incorporation of CO_2 setting sands into green-sand systems on knock-out did not lead to deleterious properties in the re-bonded sand; in fact, the green-strength properties of the clay- bonded sands appeared to be improved by the presence of sodium ions from the residual carbon-dioxide binder. On actual reclamation of the sand, resulting in a clean binder-free sand, experimental trials were being carried out with wet reclamation methods; full results were not yet available but so far the method looked most promising.

Costs

MR. STOUT asked as to how the costs of this method compared with normal methods of core making.

DR. ATTERTON replied that on the direct cost of raw material and costs of binder materials he thought on the whole it was quite fair to say it broke even—sometimes less, sometimes more than the conventional core- and resin-binders. Such costings were naturally unrealistic as they took no account of the many advantages of the carbon-dioxide process; however, even if these were ignored, the process was generally cheaper on a direct basis compared to conventional methods. The costs of carbon dioxide, so far appeared to be much less than stoving costs with oil- or resin-bonded cores. Thus, one foundry saved £50 per week by closing one core stove, whereas the carbon-dioxide bill for the same period was £20.

MR. REES, speaking on this subject, said costs were a little below resin, using 4 per cent. binder. The gas bill for 48 cylinders at 9s. per cylinder amounted to £20; one stove was closed, saving £50. Due to the high strength of a finished core there was a real saving in core irons. He also saved seven lifts on one crane per core. The moulders were given the corebox on their job and made the core as required, CO_2 being piped at low pressure to the foundry. There was no flash at the joint and, for steel, the strip was far superior, although no coating was used, in contrast to normal practice.

Chamber Process

MR. WHELDON, referring to the chamber process of using the CO_2 hardening method, said he assumed that this method would lend itself to the production of large cores of irregular shape of a jobbing nature. A fuller explanation of the chamber method and its application would be appreciated.

DR. ATTERTON said he was unaware of it being used on a production scale. Cores required about 8 to 10 times as long to harden by that method as by direct introduction of gas, but there was no reason why the method could not be used.

MR. REES then mentioned that he had made a large core roughly 16 ft. by 2 ft. 6 in. by 3 ft. without any core irons. It was previously made with six core irons and needed to be turned out on to a machined plate for stoving.

MR. BAILEY asked whether Dr. Atterton recommended ejectors in the corebox and how effective was the Hydroblast for removing CO_2-bonded cores.

DR. ATTERTON replied that the use of ejector pins was very satisfactory and had been employed already on a production scale. Binder materials were water soluble and a normal core, if soaked with water, would collapse. Therefore, the Hydroblast should be the ideal method of removing cores from a casting.

Coatings

MR. EMMERSON, referring to Mr. Shotton's concluding remarks when proposing the vote of thanks, asked whether it was possible to predict a long life for the CO_2 Process. In his works, to improve the finish of castings, he was employing a spray with a most obnoxious odour; would it always be necessary to use a coating.

DR. ATTERTON said that as Mr. Rees had shown, the use of coatings was not always necessary. However, in cases where a poor finish was obtained, it was desirable to use either a coating or addition to the sand. Both gave satisfactory results and coatings need not have an obnoxious odour.

MR. DIXON, referring to the question of cost, said Dr. Atterton gave a figure of 0.2 to 0.24 per cent. per weight of CO_2 combined with weight of sand. Was it possible to give figures on the actual weight of CO_2 used to set a certain weight of core, or cub. ft. of sand?

DR. ATTERTON replied that very much depended on the efficiency of the gassing method. Some foundries had already achieved less than one per cent. gas consumption, but the general figure, at the moment, was between one and two per cent.

MR. HAMPTON said Dr. Atterton had mentioned a core weighing 3½ tons produced by the CO_2 Process. Was the whole of the sand forming the core made of CO_2 sand as, in the normal coremaking process, special facing-sand would be used, the rest being backing sand. If the former, this would throw the cost out of balance. Dr. Atterton also mentioned unit sand; did he mean that the old sand could be used as a part of the facing sand? Did normal organic bonds mixed with CO_2 material produce satisfactory moulds, and had there been any development in the direction of re-using CO_2 material? Was there any information on results of stoving CO_2 cores?

Re-bonding

DR. ATTERTON replied that in the core mentioned the centre was filled with bricks which were included in the weight of 3½ tons. With oil-sand cores it was necessary to vary the amount of binder according to shape and section of core being made. This was not necessary with CO_2 cores, the same sand being satisfactory for a wide range of shapes. Attempts had been made to re-bond with silicate binder, but strengths were lower. Also the binder introduced small quantities of sodium salts into the sands which lowered the fusion point; by re-bonding, the sodium salt concentration might reach such a level that serious fusion troubles occurred. However, CO_2-bonded sand could probably be incorporated in the green-sand system in moderate quantities. After initial hardening it was not necessary to stove. Strength had been considered adequate for general use after a normal gassing treatment. However, a lot of work had been done with a silicate-base material which set on gassing at about 15 lb. per sq. in. and then had to be stoved. Perhaps Mr. Tipper would care to elaborate this point.

Baking

MR. TIPPER said that in his view baking brought out the full strength, otherwise only obtained by excessive use of gas. He had yet to have it proved that this was not true of any silicate-base binder. It was possible at normal baking temperatures, as used for typical oil-sand practice, to obtain strengths 4 or 5 times the strength obtained after gassing. On initial gassing of a mixture CO_2 with 4 per cent. binder, compression strength was about 50 to 100 lb. per sq. in. On standing for ½ hr., the strength increased to 250 lb. per sq. in. On baking the core for 20 min. at 200 deg. C. and then cooling; the strength was 1,200 to 1,400 lb. per sq. in. These results were from proprietary mixtures and he was not speaking in relation to the lecturer's composition. He would like to point out that this process was not new. The whole principle was outlined by two Lancashire men in 1900 and if only it had been taken up then, the process would have been in being 50 years ago.

As to the reclamation of sand, in normal core-practice there was no intention of re-using the sand —the same should apply with the CO_2 sand and he could visualize in the future the removal of unwanted material by water treatment, provided the cost of the sand came out cheaper than new sand. So far as he was concerned, not everyone had to apply a sprayed coating as Mr. Emmerson had implied. He never advocated the use of a dressing.

DR. ATTERTON said the strength figures for cores or moulds quoted seemed unduly high and unnecessary. For the majority of work those obtained by just gassing were quite satisfactory. He was speaking here of the binder described in the lecture. Regarding reclamation of CO_2 sand, the lecturer said he had been informed that there was a firm engaged in this line and according to them it should be possible to wash the sand by their technique for 3s. 6d. to 5s. per ton. Another firm undertook the drying of sand for which they charged 12s. 6d. per ton, excluding transport costs. Washing and drying costs of the order of £1 per ton should make the process worthwhile.

Dimensional Accuracy

MR. WEAVER said it seemed that the process was suitable for large, lumpy castings and when quite wide tolerances were necessary in the core equipment. Had the lecturer any experience with the dimensional accuracy of castings in bulk production which were confined to rather close tolerances?

DR. ATTERTON, exhibiting a small bibcock core, said he never recommended making cores of that size by this process. There was a definite minimum size of core below which the process was not likely

Carbon Dioxide Process

to be of economic value, but this size depended on the efficiency of gassing methods, etc. The process offered greater dimensional accuracy because of the hardening with the pattern in position in the box, and consequently there was no distortion or sagging in the " green " state or during stoving.

MR. WEAVER said that rapping the corebox did alter dimensional accuracy and it would seem necessary to get designs modified to yield adequate tapers. He did not normally rap coreboxes so much as was illustrated.

DR. ATTERTON pointed out that the box used in preparing the core (shown) was not rapped and it was not suggested that excessive rapping or mutilation of the box was necessary.

MR. HIRD, referring to the Lancashire experiment in 1900, said some of the old moulders remembered 30 years ago that the method of doing business then was that one gave a man £1 1s. 0d. and he revealed what the process was for using sodium silicate for making cores without stoving. The foundry manager bought the prescription and sodium silicate and then experimented with it, and the cores were so hard that removal was impossible. He was obtaining satisfactory skins on castings without any coating being used, and also found that only moderate rapping was required.

Taper Allowance

MR. LITTLE asked what was meant by adequate taper? He was thinking not of a small job but something of considerable depth, say, 6 ft. Had the lecturer any experience with extruded cores 1 in. dia. had he done any work on introducing CO_2 to the centre of an extruded core, thereby saving stoving.

DR. ATTERTON, replying to the second part of the question first, said the process was being investigated and it appeared to have great possibilities. As to the 6-ft. draw, nothing like this had been tackled so far, to the best of his knowledge. However, it would not be possible to strip a hardened core from such a large box unless the box was collapsible and contained loose-pieces, and this was by far the best approach. Alternatively, the high-green-strength mix could be employed and the core would be gassed after stripping.

MR. REES said collapsible patterns with loose-pieces to the coreboxes should be designed.

A MEMBER asked whether the sand could be patched.

DR. ATTERTON replied that sand could be patched but not as easily as normal oil- and resin-bonded sand. After patching it could be readily hardened by blowing gas over the patched portion.

MR. TIPPER said he had had no difficulty with patching, particularly if one was prepared to wet the joint or surface with water.

Reduction Values

He would like to comment here on the double reduction valve which was used in the demonstration. An improvement on this was to fix a distance-piece or coil between the two valves and have a heater. He used a BOR-13 valve manufactured by British Oxygen Company. The single reduction valve was found to be just as satisfactory as the more expensive double-reduction valve.

He also commented that in some cases 2 per cent. of pitch had been mentioned there, the finer grade of pitch was definitely an advantage and he would not like to go above 1 per cent.; in personal experience, if one did one got sears.

DR. ATTERTON said an electric heater as mentioned by Mr. Tipper would not be particularly suitable because of the need for a large number of electric points and also the necessity of having electric leads trailing over the foundry floor. In general there were two methods, either to have a cylinder of gas of transportable 28-lb. size (later cylinders of this type could be used for pumping into large reservoirs), or solid CO_2 could be used; the latter not in transportable units, but this type was obviously suitable for pumping gas from a solid CO_2 liquifier to various points in the foundry. The quantity of pelletted pitch required depended very much on the relative metal and sand thicknesses, metal being cast, etc., but 1 per cent. was probably the optimum value in most cases.

Magnesium Casting

MR. DIXON asked whether the lecturer had any experience with casting of magnesium. Were inhibitors necessary and was there any difficulty in incorporating them?

DR. ATTERTON replied that inhibitors could not be incorporated because they were acidic and would react with the alkaline binder, but castings had been made using an inhibited spray on CO_2 moulds in DTD 300 alloy and in pure magnesium, with satisfactory results. Also, mixes incorporating about 5 per cent. sulphur in the sand along with the binder had been found very good.

MR. DIXON said there would be no metal/mould reaction because of the lack of water in the binder.

DR. ATTERTON pointed out that there was a certain water-content in the binder, but either the inhibiting spray or sulphur in the sand was sufficient to prevent metal/mould reaction.

A MEMBER asked whether Dr. Atterton would comment on the ease of knock-out of the aluminium pipe illustrated in the Paper.

DR. ATTERTON said this one collapsed beautifully and much better than with conventional practice. This was the general rule for aluminium castings, but he should mention that he had had inferior collapsibility in certain cases.

MR. ASTON asked whether he had had any sticking in an aluminium corebox after gassing. He had had such a difficulty. Was there any lubricant one could use or could one incorporate anything in the sand to help?

DR. ATTERTON suggested that rubbing the corebox with a bit of graphite would help. Sodium silicates were alkaline and would attack aluminium. There was the possibility of incorporating a thin coating of protective lacquer or perhaps plumbago.

Notes from the Branches

Bristol and West of England

The annual dinner of the Bristol and West of England branch of the Institute of British Foundrymen took place at the Grand Hotel, Bristol, and was attended by 60 members and friends. Mr. John Bell, the president of the Institute, was the principal guest of the evening, and also present were Mr. and Mrs. G. Lambert, Mr. and Mrs. N. P. Newman, Mr. and Mrs. A. S. Wall, representing Wales and Monmouth branch, Mr. G. L. Hack, president, Bristol Engineering Manufacturers' Association, and Mr. and Mrs. E. F. Gilberthorpe, representing the Western branch of the Institute of Production Engineers.

In proposing the toast of "The Institute of British Foundrymen," MR. D. A. RICHARDS, branch senior vice-president, said that the Institute could be proud of its progress in the last 50 years. Its present membership was over 5,000, and the work of its technical and education committees had done much to improve the knowledge of foundrymen in many foundry matters, through the medium of reports, lectures and courses for foremen. Much of the work published in such reports had been the subject of co-operative efforts on the foundry floor by Institute members, and was therefore, of practical value to members of both the foundry industry and the Institute.

MR. JOHN BELL, in replying to the toast, said that the work of the Institute was of the greatest national importance, this was reflected by the great interest shown by H.R.H. the Duke of Edinburgh, who had recently been elected an honorary member of the Institute. Referring to the Institute's National Works Visit Day, which is to be held in the Bristol branch area this year, Mr. Bell said this event serves to increase the ties between the various branches, enabling members to see the type of work done in different parts of the country. The Institute's many technical committees were fully occupied on subjects which required investigation and all these problems were being tackled in foundries throughout the British Isles, with one object in view—the solution of the individual problems for the benefit of all engaged in the industry. Mr. Makemson had done much for the Institute in his lifetime, said Mr. Bell, and the members could feel pleased in the knowledge that Mr. Lambert was carrying on the good work of his predecessor.

The toast of "The Bristol and West of England branch" was proposed by MR. LAMBERT, who said that although a comparatively new and small branch it had in its short lifetime produced a national president, who now held the office of national treasurer of the Institute, and who is president of the Joint Iron Council, and chairman of the Council of Ironfoundry Associations; two branch members had been awarded the British Foundry medal in successive years, a former branch secretary had been awarded the Institute's Meritorious Services medal, while five branch members had been awarded Institute diplomas. In its early days, said Mr. Lambert, the branch had made good progress through the secretaryship of Mr. A. Hares, and this work was now being effectively carried on by the present secretary, Mr. G. W. Brown. The secretary's task in organizing so large a branch area as the Bristol branch was no easy matter, and it speaks well for the enthusiasm of Mr. Hares and Mr. Brown that the branch has made much headway.

"Paid on the Nail"

Replying on behalf of the branch, MR. H. V. HEATH, branch-president, said that in all avenues of life we are dependent upon castings in one form or another, and the Bristol branch had reason to be proud of the foundries in its area, many of which were producing articles famous all over the world. Much work on the recent foundry developments had been carried out by branch members of whom they were proud. Records showed that founding had been carried on in Bristol as early as 1644, while it was quite reasonable to suppose that the brass pillars known as "Nails" to be seen in Bristol outside one of the old buildings, and from which originated the phrase "Paid on the Nail," were cast in Bristol foundries early in the seventeenth century. It might interest the audience, said Mr. Heath, to know that it had been reported that there were more foundries in the greater Bristol area than in the whole of Canada.

In welcoming the visitors and ladies, MR. D. P. WILLIAMS, branch junior vice-president, said that members were always pleased to welcome the ladies to the annual dinner. Foundrywork was the basis of all engineering, and he hoped that the visitors from the engineering industry would make their associates aware of the need for permanent liaison between customer and founder, for only by such means could both parties obtain the greatest satisfaction.

MR. G. L. HACK suitably replied on behalf of the visitors. After the dinner, an enjoyable evening was enlivened by entertainment supplied by local artists.

Aluminium Development Association

At the annual general meeting of the Aluminium Development Association, held in London last month, DR. HORACE W. CLARKE (chairman and managing director of James Booth & Company, Limited) was elected president. He was one of the founders of the Development Organization which was created in 1941, and when it was absorbed by the present Aluminium Development Association ten years ago, he became its first president. He has again been elected to hold this office in the centenary year in Britain of aluminium as a commercial metal.

Dr. Clarke was the pioneer in this country in the development of "Duralumin," which led to the use of strong light-alloys in airships, and later to aeroplanes. This early work advanced the internal combustion engine for aircraft in world war I, and the strong aluminium alloys used in 1921 in the construction of the first "all-metal" aeroplane—the "Silver Streak" by the Short Brothers—were produced under Dr. Clarke's direction.

Dr. Clarke, a life governor of Birmingham University, was the prime mover in 1946 in inducing the non-ferrous metals industry to endow a Chair of Industrial Metallurgy at Birmingham University—the first of its kind in the world. In 1948 the degree of Doctor of Science was conferred on him by the University. A former vice-president of the Institute of Metals, Dr. Clarke has been a member since 1915. In 1946 he was elected a Fellow of the Institution of Metallurgists, and in 1954 received the Insignia Award in Technology of the City and Guilds of London Institute. Also elected vice-president of the Aluminium Development Association was the Hon. Geoffrey Cunliffe, deputy chairman and managing director of the British Aluminium Company, Limited.

IT MAY ENCOURAGE potential exporters to the Argentine to know that after a gap of several years, Foundry Services (Overseas) Limited, Birmingham, have been able to resume shipments to Argentina and despatched consignments to Buenos Aires of f.o.b. value £36,000 during the last four months of 1954.

Industrial Output and Wages Rise

Industrial production continues to rise. Estimates prepared by the Central Statistical Office show that the index of industrial output for March (1948 = 100) is expected to be 139-140, compared with 132 in March, last year. The early estimate for February (137-138) has been amended, on additional information to 138 and the figure for January has been revised upwards from 133 to 134. Figures for the corresponding months last year were 132 for March, 130 for February, and 127 for January.

No correction of these figures has been made for seasonal influences or for annual or public holidays. But they would seem to suggest that output for the first quarter of this year has been between 3 per cent. and 4 per cent. above the average for the whole of last year. This would be an improvement on the level of 2 per cent. or 3 per cent. above the 1954 average mentioned by the Economic Survey as the then "present level."

The high level of the nation's industrial production is also reflected by a big increase in wage rates. According to the "Ministry of Labour Gazette," the index of weekly rage rates (June, 1947 = 100) rose to 149 at the end of March, compared with 146 at the end of February.

Changes in rates of wages reported during March resulted in an increase estimated at approximately £1,266,000 in the weekly full-time wages of about 3,119,000 workpeople. The principal increases affected workers employed in engineering and shipbuilding, motor vehicle repairing, and the iron and steel industry. For the first three months of the year there has been a net increase of £2,432,900 in the weekly full-time wages of 7,638,000 people. In the corresponding quarter of 1954 the increase was £826,000, affecting 3,415,000.

Nearly 56,000 workers were involved in industrial disputes during March, and about 148,000 working days were lost. In the previous month 50,000 workers were involved and 156,000 working days lost.

English Steel Corporation's Offer.

Lists open and close to-day, May 12, for the offer to the public of the preference and debenture capital of the English Steel Corporation, Limited, Sheffield. The company's ordinary capital of 6,000,000 £1 "A" shares and 2,000,000 £1 "B" shares was disposed of by the Iron and Steel Holding and Realization Agency last June, when the former were bought by Vickers, Limited, and the latter by Cammell Laird & Company, Limited.

The present offer consists of 5,000,000 5½ per cent. £1 cumulative redeemable preference shares at 20s. each and £5,000,000 4½ per cent. debenture stock at £100 per cent. One quarter of the price will be payable on application in each case. The remainder is due on June 8 and a full half-year's dividend or interest will be paid on June 30 to holders registered on June 15.

The company will have the right to redeem the preference shares in whole or in part in a 30-year period beginning June 30, 1974, at 22s. until June, 1984, 21s. until 1994, and thereafter at par. This basis or a six-months' average market price, whichever is greater, will also rule for repayment in liquidation or return of capital.

DURING their visit to Gloucester on Tuesday the Queen and the Duke of Edinburgh toured the works of the Gloucester Railway Carriage & Wagon Company, Limited.

Health of the Executive in Industry

The health of a large part of the workers in industry to-day is rigorously protected, but perhaps more attention should be paid to the well-being of the executive. A reference to the "pressing health problem" of the administrator was made at the congress of the Royal Sanitary Institute at Bournemouth by Prof. R .E. Lane, Nuffield Professor of Occupational Health at Manchester University, who said that modern industrial methods combined with social conditions were throwing increasing stress on members of the managerial hierarchy. It was an industrial problem of the first importance, which, he declared, called for wider recognition.

The medical supervision of workmen engaged in dangerous processes could no longer be carried out adequately without laboratory facilities. There was a great need for reliable regional centres where investigations could go on. Committees should be set up in every region to help to plan the struggle for an efficient and practical industrial health service. In Britain, enlightened management was profoundly aware of the existence of the newer medical problems of industry, but "medicine, clinging to traditional approaches, has so far failed to play its full part."

Air Vice-Marshal E. D. Dalziel Dickson, honorary surgeon to the Queen, spoke on noise at work. Acoustic trauma, the result of exposure to noise of high intensity, was to-day perhaps the most frequent threat to the ears in industry, he said. The best method of protection was the use of ear defenders fitted to a headband. Cotton wool offered no protection with present noise levels. Air Vice-Marshal Dickson said he thought that management had not sufficiently appreciated the possibility of increased efficiency and production through curtailment of noise.

Clyde Shipping Orders

A welcome fillip to work on hand at Clyde shipyards has been received during the past week or so with the placing of contracts for three vessels with the Ailsa Shipbuilding Company, Limited, Troon. One is for a cargo motorship of 1,700 tons dw. and 1,400 tons gross for the Constantine Shipping Company, Middlesbrough. A Diesel-driven ferry of about 800 tons, capable of carrying 1,200 passengers and 40 cars, is for the British Transport Commission's Clyde services. It will be an enlarged version of the Bute and the Cowal, both of which were constructed by the same builders. The third order is for a Diesel-driven coastal tanker of about 1,000 tons gross for the Director of Army Contracts. The Ailsa Company have also on hand three other cargo motorships—two for Irish Shipping and one for Glasgow owners. Orders for two small craft—a Diesel tug for the Clyde Shipping Company, Limited, and a small tanker—have been received by A. & J. Inglis, Limited, Glasgow.

Another new order has just been added to the list: it is for a tanker for the Scottish Tanker Company, Limited, and is to be built by John Brown & Company, Limited, Clydebank. This is understood to be the first tanker order to be placed by British owners for over a year. The new vessel will be named Scottish Ptarmigan. This year the Clyde yards have already received almost the same number of contracts as they did during the whole of 1954. Some of the smaller yards have benefited from the flow of new contracts.

New Equipment

Dust-extraction Plant

Holman Bros., Limited, of Camborne, Cornwall, have now developed a whole range of equipment for the exhausting of dust and fume from foundry processes of surface grinding, bench grinding, pneumatic chiselling, swing-frame grinding, metal melting in crucibles, etc.

The basic system is called the "Dusductor,"* and depends on extraction of dust and fume close to its point of origin by a relatively low-volume exhaust at high velocity. This work has been done in close collaboration with Mr. W. B. Lawrie (HM Engineering Inspector of Factories)† with special reference to the new "Foundry Regulations" legislation, further important clauses of which come into operation in January, 1956. Impetus was given by the success achieved by Holman Bros. with their Dryductor system of extracting dust from rock-drilling operations by exhausting at high velocity (14,000 ft. per min.) through a hollow drill.

Several of the applications of the Dusductor system which have already reached a high standard of efficiency are as follow:—

Swing-frame Grinder.

A 16-in. dia. by 2-in. wheel swing-frame grinder of conventional design has had special extraction take-off louvres of aerofoil design built inside its guard. In addition, air-suction vanes have been incorporated in the trajectory of sparks and heavy particles. The whole is connected to a 3-in. bore take-off flexible exhaust, extracting at 250 to 270 cub. ft. per min. at 2½-in. mercury suction. (The latter being provided by a motorized Sturtevant fan of 300 c.f.m. nominal capacity at 5.2 h.p.). That the system is remarkably efficient was recently witnessed by the writer at a demonstration in the Cornwall works. Photographs taken of the swing-frame grinder with the exhausting system "working" and "off" are reproduced in Figs. 1 to 4. (These and subsequent photographs are taken

* "Dusductor" is a registered trade mark.

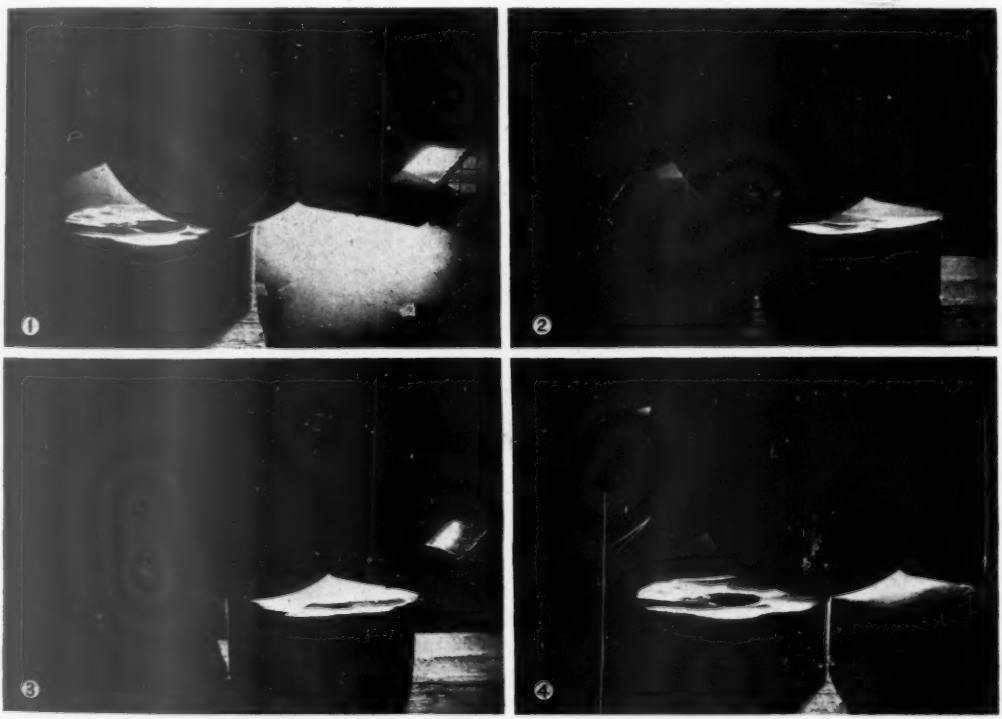
† *Vide*: [1] Lawrie W. B., Holman A. T., and James E. B.: "Observation and Control of Dust at Portable Abrasive Wheels and Pneumatic Chisels," *Proc.* Inst. Mech. Engs., 1954.

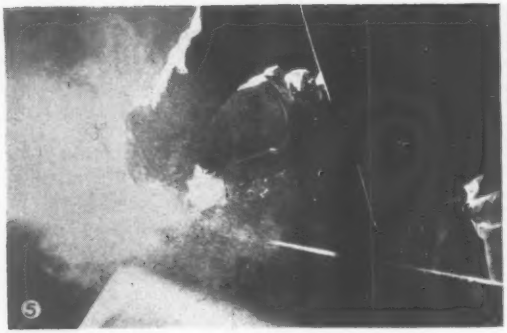
[2] Lawrie W. B., Holman A. T., and James E. B.: "Observation and Control of Dust on a Pneumatic Chisel, a Portable Abrasive Wheel and a Bench Grinder". Paper presented to the London branch of the Institute of British Foundrymen (shortly to be published in this JOURNAL).

[3] Lawrie W. B., Holman A. T., and James E. B., "Low-volume, High-velocity Exhaust." *Proc.* BCIRA Conf. on "Foundry Ventilation and Dust Control," Harrogate, April 1955.

FIGS. 1 TO 4.—*Grinding grey iron with a* 14-*in. dia. swing-frame machine: Fig.* 1 *without exhaust; Figs.* 2, 3 *and* 4 *with exhaust working. Figs.* 2 *and* 3, *dust control with the wheel over edge of casting nearest operator and Fig.* 4 *control when grinding on the remote edge.*

(Courtesy, British Cast Iron Research Association.)





(Courtesy, British Cast Iron Research Association.)

FIGS. 5 AND 6.—*Portable surface grinder in use on a bath casting. Fig. 5 without and Fig. 6 with the exhaust ventilation working.*

FIGS. 7 TO 10.—*Local, high-velocity, low-volume exhaust applied (Figs. 7 and 8) to crucible melting of flux-covered magnesium alloy and (Figs. 9 and 10) to open risers of castings poured from that metal. Photographs, Figs. 7 and 9 are taken with the exhaust "off" and Figs. 8 and 10 with it "on." Note the slight leakage in Fig. 8 because the annular ring does not exactly fit the pot. In Fig. 10 fumes from a vent are also flowing into the exhaust ring.*

(Courtesy, British Cast Iron Research Association.)

with the Tyndall-beam dust-illumination system developed for such work by W. B. Lawrie and referred to on numerous occasions in this JOURNAL.)

Bench Grinder; Radial, Portable Grinder, and Pneumatic Chipping Hammer.

For the 8-in. bench-grinder system, exhaust is arranged for a wheel 1-in. wide of about 45 cub. ft. per min. at 4½ to 5 in. of mercury. Two stripper louvres are incorporated inside the guard leading to a bifurcated take-off. Details of this design and working characteristics were quoted and illustrated in the Paper.[5] This same remark also applies to the Dusductor systems developed for radial portable grinders up to 8-in. dia. and pneumatic chipping hammers. In the former case, a 6-in. wheel at a peripheral speed of 9,000 surface ft. per min. is exhausted through a ¾-in. dia. flexible hose by an induced vacuum of 6 in. of mercury at the rate of 23.5 cub. ft. of free air per min., three ports being arranged inside the hood. For the pneumatic chipping hammer an induced vacuum of about 12 in. of mercury is employed to give an extraction rate of approximately 25 cub. ft. of free air per min. through the shank of the hollow chisel—a velocity of about 12,000 ft. per min. in the ⅜-in. dia. flexible hose.

Surface Grinder.

For exhausting from a portable surface grinder (Figs. 5 and 6) an annular ring of seamless steel tubing is incorporated into the hood, with drilled holes for extracting and connected to a flexible hose of ¾-in. bore. The model shown takes out about 25 cub. ft. per min. of air at a vacuum of 5 in. of mercury. Hole sizes and spacing within the annular ring are critical, as air movement adjacent to the wheel is of the order of 2,500 to 3,000 linear ft. per min.

Fumes from Melting Pots and Riser Heads.

A device similar to that used in the surface grinder has been developed by Holmans, working at T. H. & J. Daniels, Limited, of Stroud, for the extraction of fumes when melting magnesium and from the riser after pouring. These are shown in Figs. 7 to 10. For the melting pot, an annular ring 14-in. dia. is employed, aspirated continuously at 170 cub. ft. per min. at a vacuum of 1.1 in. mercury. For the smaller (7-in.) ring, such as is used on the feeder head, extraction is at 90 cub. ft. per min. at about the same suction.

Complementary Arrangements

As ancillaries to this apparatus, Holman Bros. have available a rotary exhauster, made by their associated company, Climax Rock Drill & Engineering Works, Limited. The direct-coupled model, No. 2, of this plant, with a displacement of 62 cub. ft. per min., and a maximum vacuum on a closed system of 96 per cent., has working characteristics very suitable for employment in such extraction applications as have been mentioned—with the exception of the swing-frame grinder or other very large models. The company also has co-operative arrangements with makers of filter-bags and unit dust-collection plant of designs complementary to the extraction systems.

Details of the availability of the various cowls on a commercial scale and the Dusductor service will shortly be issued by Holman Bros., Limited. Further work with users of the systems is also envisaged, on a co-operative basis. It is significant that only at this late stage has the commercial side of the developments been considered. The directors of Holmans take a somewhat altruistic view and will be well satisfied if their systems prove that a really worthwhile advance has been made in rendering safe working conditions for operators on dust-producing operations. Viewed from this aspect, no apologies are needed for treating the subject at such length in this article, and both the staff of the firm and Mr. W. B. Lawrie are to be congratulated on the solid progress achieved. It is believed that in this type of dust-extraction work in foundries the United Kingdom leads the rest of the world.

Improved Fery Radiation Pyrometer

An advantage of the Féry radiation pyrometer is that no direct contact with the hot body is required and the heat-receiving unit or telescope may, therefore, be located a short distance away. Thus, during many years this instrument has been widely used for the measurement of high temperatures under conditions that precluded the use of pyrometers of the thermocouple type. An improved model has been designed recently by the Cambridge Instrument Company, Limited, 13, Grosvenor Place, London, S.W.1. It is of much heavier and more robust construction than that previously employed, thereby decreasing the liability to error due to local heating and rendering a protecting cowl unnecessary. Féry pyrometers are frequently exposed to dust and fumes; the telescope is, therefore, fitted with a protective screen of special glass, easily replaceable, and allowance is made in the calibration of the outfit for loss due to absorption of radiation. A moulded terminal box is fitted for the thermocouple connection, a distonic scale being provided so that it can be set to operate at distances from 3 ft. to infinity; this is claimed to be considerably simpler than the optical focussing device of the older pattern. A locking screw is provided to ensure that the setting is not accidentally changed. The telescope is mounted by a hinge on heavy 1-in. steel tubing which may be clamped to a pipe permanently fitted to the furnace wall, or may be fixed by means of a special support.

Corrosion of Steel Structures

A brochure from Bitulac, Limited, Collingwood Buildings, Newcastle-upon-Tyne, describes the firm's "Bitulac" anti-corrosive treatment of structural steel and the like. Typical applications, including electro-chemical works in France, hydro-electric pipelines in Spain, bridges in India, and water tanks in Britain and abroad are illustrated.

The company claims that by its treatment complete protection is given however bad the conditions, even under water or beneath the ground. Complete technical service facilities are offered.

Furnace Installations

A leaflet issued by Stillite Products, Limited, 15, Whitehall, London, S.W.1, gives technical details of "Therbloc," a relatively new material that has undergone successful practical trials on various types of furnace during the course of the last two years. It is a lightweight insulating slab of resilient texture manufactured from mineral wool.

Although "Therbloc" can be used without other refractory materials, it is primarily intended as a backing to conventional insulating bricks. In some cases, it has been used immediately behind the sheet-metal lining, and a recent example is a heat-treatment furnace operating at approximately 450 deg. C.

Company News

HARLAND ENGINEERING COMPANY, LIMITED—The directors announce an ordinary dividend for 1954 of 14 per cent., against 11 per cent. for the previous 12 months.

MODERN MACHINE TOOLS, LIMITED—A firm offer for the company's 600,000 5s. stock units has been received from the Gas Purification & Chemical Company, Limited, which undertakes to issue three of its 2s. shares for every eight MMT units or, alternatively, to procure purchasers for cash at 14s. a unit.

INTERNATIONAL COMBUSTION (HOLDINGS), LIMITED—An extra-ordinary meeting will be held on May 17 to consider increasing the capital to £4,000,000, and capitalization of reserves for a one-for-two scrip issue. After the free issue there will remain 3,889,060 unissued 5s. shares which the directors do not intend to issue at present.

ENGLISH ELECTRIC COMPANY, LIMITED—The company announces the completion of a purchase of 99 per cent. of the shares of the Amalgamated Electric Corporation, Toronto, Canada, which was formed in the 1880s. Its products include electrical distribution and lighting equipment, motor control apparatus, and wiring supplies.

WOLVERHAMPTON METAL COMPANY, LIMITED—An extra-ordinary meeting has been called to approve an increase in the authorized capital from £500,000 to £1,000,000, and the capitalization of £197,000, part of the company's undivided profits. The latter will be used in making the free scrip issue of one 5s. ordinary share for every two units held.

QUALCAST, LIMITED—With profits at April 30 ahead of the corresponding period a year ago, Mr. J. E. V. Jobson, chairman, expects that the company will be able to recommend an increase in the final payment of 15 per cent. last year. To date, tonnages of castings, sales of finished products, and wage bills are running at record levels. Order-books are full and outputs are going steadily ahead.

MINERALS SEPARATION, LIMITED—For 1954 a dividend is announced of 15 per cent., making 20 per cent., on capital increased by a 300 per cent. scrip issue. The equivalent total in 1953 was 17½ per cent. Mr. J. N. Buchanan, chairman, says in his report: "Our tendency is to move towards the character of an investment trust company," and, he continues, "out of money realized from the Rhodesian and other sales, we have made considerable investments in equities in the USA and Canada."

£2,000 Damages for Fitter

Agreed damages of £2,000, with costs, were awarded at the Yorkshire Assizes in Leeds to Enzor Herbert (51), a fitter, of Zion Lane, Sheffield, who sued his employers, Millspaugh, Limited, manufacturers of papermaking machinery.

Mr. R. Withers Payne, for Herbert, said that in 1944 the company introduced a new process of melting metal compound, which resulted in offensive and unpleasant fumes. Herbert developed headaches, vomiting, and dizziness, which led to high blood pressure, peptic ulcers, and partial paralysis of his right arm.

AN ORDER for a motor vessel of 9,825 tons d.w., the largest ordered on Tyneside so far this year, has been placed with R. W. Hawthorn, Leslie & Company, Limited, by the Moor Line, Limited.

Book Review

Iron Moulding for Apprentices, by Francis D. Roper. Published by Ernest Benn Limited, Bouverie House, Fleet Street, London, E.C.4; price 15s. net.

Everyone concerned with the practical training of foundry apprentices will welcome this addition to the meagre list of text-books now available to the practical foundryman. The author is well placed to judge the needs of the young apprentice and no doubt his experience at the National Foundry Craft Training Centre has influenced the choice of subject matter and the style of presentation. The historical introduction was a happy thought. The book is easy to read and the illustrations and diagrams are clear and informative.

To compress into 134 pages a complete and detailed picture of the basic principles of the craft is no mean achievement and omissions there are bound to be in such a text-book. Thus, readers may feel that the chapter on loam moulding does not adequately illustrate the wide applications of this type of foundrywork, while the section dealing with open-sand moulding could have included, with advantage, the making of core-irons and grids as well as plates.

Although the book is primarily for apprentice moulders, a section on coremaking would have made a valuable addition to the chapter on cored work. Foundry terms are used extensively throughout the book, occasionally without adequate explanation, thus emphasizing the real need for a standard glossary of terms used within the industry. These omissions, however, need not detract from the value of the text-book as a summary of the minimum knowledge an iron moulder should gain during his apprenticeship and, no doubt, the book will find widespread application as a supplement to the practical training now given throughout the industry. W. S. M.

Publications Received

Bulletin of the Association of Bronze and Brass Founders, No. 40, opens with an appraisal of the results obtained through the great effort made in connection with the Conditional Aid Advisory Service. It has gained much desirable publicity for the Association. It has received more technical assistance from the British Non-Ferrous Metals Research Association. It has created a useful and pleasing liaison with many foundries which are not members of the Association. Though the members of the Association produce about 85 per cent of the tonnage of brass and bronze castings made in the United Kingdom, the Association needs, and indeed well merits, a still greater membership.

Machining Aluminium. Published by the Aluminium Development Association, 33, Grosvenor Street, London, W.1. Price 2s.

This is a revised edition of a booklet first published in 1944; the earlier one was restricted to wrought materials, but the new one includes cast alloys.

Filing is a process which often gives trouble to the metal patternmaker and wisely a paragraph has been devoted to it. If filing results could be associated with the various alloys, the usefulness of this booklet would be enhanced. Perhaps, to quote a letter received with this brochure, "It is a major difficulty in dealing with this subject for any metal that day-to-day practice is bound up with many factors which can be determined only by trial and error." The great experience behind this book must make the specifications recommended essentially comparable one with another.

Progress and Development of the Foundry Industry

Mr. H. Sunderland's Presidential Address.

In the course of his address to the West Riding of Yorkshire branch of the Institute of British Foundrymen, Mr. Sunderland drew a parallel with the progress made in other industries in an equivalent space of time and continued as follows:—

The word "time" is a reminder that the art of founding was in common use at the dawn of history and shares with the craft of the mason the honour of being the oldest manufacturing process known. The metal work often disclosed in the excavations of ancient cities is of a high order and some of the statues and works of art which have been discovered exceed in quality many present day products. In these ancient times they also made use of processes which are claimed to be of recent development, a prominent example of which is the lost-wax process.

From the beginning of man's needs then, the foundry industry has developed from an art creating objects of beauty to an industry producing items of utility on an astounding scale. In other words it has changed from a fragile faun to a powerful collosus. Here it should be noted that development emphasis has been mainly on quantity and not so much on method, achieved one might say, with the delicacy of a bulldozer. So, if and when the day of assessment arrives and the fatal question is put to the industry "what have you done with your time in the last 2,000 years apart from panderings to the needs of humanity" the answer will be made in a very small voice.

It is not possible to compare the progress made in other industries over such a large span of time, because they are young and have developed within the space of a lifetime. But nevertheless, great strides have been made both in mass production and manufacturing techniques. It may be said that the science of electronics, physics and chemistry offers more scope for development, but I fail to grasp the point of such reasoning and I wonder if the fault lies in our own inability to see far enough into the future.

Young Industries

To illustrate this point and taking examples from the young industries just mentioned, I would like to draw your attention to radio with which we are all familiar in our homes. As a boy I used to dabble with this new toy and remember listening with rapt attention to the faint sounds coming from the earphones through a crystal set. Radio at that time had emerged from the phase of an interesting laboratory experiment to a practical means of communication and has developed rapidly since then to the wonderful devices produced and used to-day, including such important equipment as the electron microscope for the study of diseases. Radar for the guiding of ships through the dangerous places of the sea, and even a radio telescope which can probe the depths of space far beyond the ken of any optical telescope which ever could be made, and I ask you, who at the time of the crystal set would have been so brave to predict such advances?

The chemical industry has advanced along similar strong lines with no less spectacular results. New drugs, synthetics, plastics and a vast number of substances which have improved the lot of man, lengthened the span of his life and eased the burden of pain in our hospitals. Here again, who would have ventured to mention such possibilities at a time when carbolic acid was the most effective antiseptic known.

Surely in the casting of metals, discoveries of similar merit are possible, and the foundry of the future can be a place of marvels—in fact these developments may be forced upon us. First by the shortage of fuel, as the coal resources of this country are coming to an end, with the result that such devices as the foundry cupola will become museum pieces. But the melting of metals must go on and the scope offered by this necessity may finalize itself into melting equipment which by some simple control will produce a continuous stream of metallurgically perfect metal, or with a flick of the wrist the flow can be stopped, there will be no cold metal, no surplus of molten iron, no dropping of cupola bottoms which, though very spectacular, could not be described even by its strongest supporters as other than crude. Imagine in its place, a cool, clean, dustless apparatus controlled by a white-coated foundryman who can concentrate upon the essentials of metal requirements rather than be wondering whether the patching he put upon the cupola lining that morning is going to stand up to the afternoon blow.

Making of Moulds

It may be found possible to dispense with the use of sand as a mould material—such a change is possibly overdue—to take away the dirt from the work of moulding and cut out the variable factors which sand brings to casting production. Personally, I am not convinced that methods such as the shell-moulding process will be the complete answer, but can serve as a guide to point the way to some ideal solution to the elimination of sand.

Moulding machines still lag behind in utilization of modern ideas compared to machines and devices in common use by the toolmaker engineer. Such machines can produce objects in 3D form from a drawing without a pattern. Who knows, these pipe dreams may be an actual possibility within the next decade, if we can exclude from our minds the constant and irritating obstacles to the production of sound castings caused by sand, metal and other almost unpredictable elements. But rather let us ask ourselves the question "Is it necessary to do this thing, or is that material essential?"

All this is far reaching and would constitute a revolution in the foundry industry, which would

result in a greater concentration of thought upon the casting itself, and the foundry would be changed from the rather grim buildings we know to-day, to a clean hygienic working place wherein craftsmanship will become a science, and crude labour reduced to a minimum.

Vote of Thanks

MR. COLLINSON, in proposing a vote of thanks, said he "did not believe a word of it." He was afraid foundries would be using sand for a long time, but he thought Mr. Sunderland had omitted one factor, a factor which was just as irritating as the sand, and that was the fumes and dust. The president had referred to electronics. This was a science which was used by very superior people but it was a development which could be very useful in a foundry. When a pattern came in there were divers ways in which it could be moulded and the many people in the foundry have many and different ways of making it, each unfortunately having prejudices. An electronic computer had no prejudices, not only did it add two and two together, but it could also decide which is the most economical answer to a certain set of conditions. He was quite sure the economics of a foundry would be materially helped when the electronic computer was as easily handled as a slide-rule.

MR. BOLTON seconded and MR. SUNDERLAND shortly replied.

Steel Output's New Peak

Industry's Prospects for the Current Year

Steel production in March averaged 394,900 tons a week. This compares with an average of 394,200 tons in February, which was the highest rate previously achieved. During the first quarter of this year, steel production totalled 5,074,000 tons, compared with 4,694,000 tons during the opening quarter of last year. Pig-iron production in March averaged 240,700 tons a week, compared with an average of 241,700 tons in February.

Latest steel and pig-iron output figures compare as follow with earlier returns:—

TABLE I.—*Pig-iron and Steel Output.*

Period.	Pig-iron.		Steel ingots and castings.	
	Weekly average.	Annual rate.	Weekly average.	Annual rate.
	Tons.	Tons.	Tons.	Tons.
1955—January ..	236,400	12,292,000	380,600	19,789,000
February ..	241,700	12,567,000	394,200	20,498,000
March ..	240,700	12,516,000	394,900	20,536,000
1st qtr. ..	239,700	12,463,000	390,300	20,295,000
1954—January ..	229,600	11,941,000	360,300	18,737,000
February ..	222,300	11,557,000	357,300	18,577,000
March ..	230,900	12,007,000	364,800	18,969,000
1st qtr. ..	227,900	11,848,000	361,100	18,777,000

The Iron and Steel Board states that the outlook for steel supplies in 1955 can be summarized in broad terms in the following table:—

TABLE II.—*Steel Supplies (Million Ingot Tons).*

	1953 (actual).	1954 (actual).	1955 (estimate).
Steel production	17.6	18.5	19.5
Imports	1.1	0.5	1.4
Re-usable material ..	0.4	0.4	0.4
Producers' stocks	0.3 (inc.)	0.1 (dec.)	—
TOTAL SUPPLY ..	18.8	19.5	21.3

The Board points out that steel production in the first quarter of this year, compared with the corresponding period of last year, has increased rather more than is implied in the forecast for the full year given in Table II. Every effort is being made to arrange raw material supplies on a basis which may make it possible for production to exceed the estimate given in Table II. This will involve considerably increased imports of ore and of other materials, including scrap.

Imported iron-ore supplies have been tight during the winter months owing to shipping difficulties. The Iron and Steel Board states that this position is now easing and increased supplies are coming forward. Supplies of pig-iron and of home and imported scrap have been expanding. The following figures are given for the first quarter of 1955, with details for the first quarter of 1954 in parentheses:—Home ore production, 4,083,000 (4,044,000) tons; imported ore arrivals, 2,531,000 (2,824,000) tons; pig-iron production, 3,116,000 (2,962,000) tons; pig-iron imports, 90,000 (101,000) tons; home steelmaking scrap supplies, 2,484,000 (2,415,000) tons; scrap imports, 267,000 (238,000) tons.

Imports of steel fall into two broad classes. First, the imports of ingots and semi-finished steel which are imported centrally by the steel industry for further processing by steel firms into finished steel products. Second, the finished steel products imported directly by steel users. The centrally purchased imports of ingots and semi-finished steel are expected to increase from 120,000 ingot tons in 1954 to 600,000 ingot tons in 1955. Contracts have already been placed for rather over two thirds of this tonnage covering deliveries well into the second half of the year. Imports of ingots and semi-finished steel early in the year were still running at the 1954 rate. A higher rate of delivery is expected from April onwards.

Imports of finished steel products were already running at the rate of about 800,000 ingot tons a year in the first two months of 1955, and seem likely to continue at approximately this rate. About half the total finished steel imports are in the form of sheets.

Provisional figures show that last year steel users, including merchants, reduced their stocks by 124,000 tons to 3,403,000 tons. The whole of the fall, which amounted to about 3 per cent. of the total stock, occurred in the second half of the year.

Pressure of demand from home industries has continued to be heavy with order-books still showing a rising tendency. There are still problems of meeting expanding requirements in some cases, and these are receiving the attention of the Board and the industry. Exports have also been in strong demand. Apart from sheet and tinplate, exports are not subject to allocation control, but makers are limiting commitments to a rate only a little over that of 1954 in order not to check the expansion in home supplies.

On the basis that total supplies of steel are likely to be between 9 per cent. and 10 per cent. greater in 1955 than in 1954, the supplies to home users should increase from just over 16,500,000 tons delivered in 1954 to over 18,000,000 tons in 1955. This increase would be greater than in any other post-war year and well over twice as great as the average annual increase in deliveries since the war.

News in Brief

AN APPLICATION to add a 50,000 sq. ft. extension to their Newhouse works has been submitted to the Board of Trade by Honeywell-Brown, Limited.

THE ANNUAL " contact evening " of the National Hardware Alliance organized in conjunction with the British Industries Fair, was held at the Grand Hotel, Birmingham, on May 4.

ADVANCE MOTOR SUPPLIES, LIMITED, report the opening, in the very near future, of a new London depot at 119, Uxbridge Road, W.12, for the supply to the trade of motor components.

ONE-DAY CONFERENCES on " Fuel Efficiency Pays " are to be held in Norwich and Cambridge on July 13 and 14, respectively. They are sponsored by the National Industrial Fuel Efficiency Service.

Mr. JOHN F. THOMPSON, in his address to the shareholders of the International Nickel Company of Canada, Limited, stated that 4 per cent. of the production of nickel enters into cast iron.

A NEW FACTORY for the production of machine-tools is being built by the Sheffield Twist Drill & Steel Company, Limited, at Worksop, Notts, at a cost of £100,000, and will come into production next year.

ON April 28, the Nottingham office of Burton, Griffiths & Company, Limited, one of the B.S.A. Group of companies, moved to new premises at 18, Carrington Street. Telephone: Nottingham 53201.

OVER 500 EMPLOYEES and friends of William Turner, Limited, pneumatic engineers, Eyre Street, Sheffield, attended the annual dance of the firm's sports club at the Locarno ballroom, Sheffield, on May 2.

BECK & POLLITZER, LIMITED, 180, Lambeth Road, London, S.E.1, state that they have again been appointed official lifting contractors at the Engineering, Marine and Welding (and Foundry) Exhibition, 1955.

A HOME HEATING exhibition, arranged by the Sheffield and Rotherham Joint Service Committee of the Coal Utilisation Council, is open on Sheffield Moor until May 14. The appliances demonstrate the efficient use of coal, coke and other solid fuels.

A CONTRACT for the reconstruction of the superstructure of bridge No. 57 on the Stour Valley line, has been placed with the Butterley Company, Limited, of Ripley, by British Railways (London Midland Region).

G. & J. WEIR, LIMITED, Glasgow engineers, are making a bonus payment to all employees with more than three months' service of £5, plus £1 for each year of service, to celebrate their diamond jubilee as a limited company.

FABRIMETAL, FONOFER (a non-ferrous foundry group) and the *Association Technique de Fonderie de Belgique* have formed a national society for the purpose of popularising the use of castings and are sponsoring a stand at the Liège Fair.

THE ZINC DEVELOPMENT ASSOCIATION and its affiliates, the Hot Dip Galvanizers, the Zinc Alloy Die Casters and the Zinc Pigment Development Associations, announce their change of address to 34, Berkeley Square, London, W.1. (Tel.: GROsvenor 6636).

SEVENTEEN of the exhibits in the Royal Photographic Society's spring show in London showed views of work in the Sheffield works of the English Steel Corporation, or their finish products. They included a colour print by Mr. A. Faulkner Taylor of an electric-arc furnace being tapped.

RUGELEY URBAN COUNCIL decided at its meeting on April 27 to grant an application by the Birmingham Aluminium Casting Company, Limited (one of the Birmid Industries group) for permission to build a light-alloy die-casting factory on the industrial site at Redbrook Lane, Rugeley.

MEMBERS of the British Cast Iron Research Association, who met in Harrogate recently, were guests at a dinner at Bradford Town Hall, and among those present were Mr. S. H. Russell (president of the association), the Lord Mayor of Bradford (Ald. H. J. White), Sir George Barnett (chief inspector of factories), and Sir Arthur Croft.

CRAVENS RAILWAY & WAGON COMPANY, LIMITED, rolling stock manufacturers, Darnall, Sheffield, have received an order worth about £2,000,000 from British Railways. It covers 36 each of Diesel railcars, and trailers, 25 coaches and 2,000 mineral wagons. The order is part of the British Railway's plan of modernization.

A NEW RUBBER MATTING for factory operatives to stand on is announced from Dunlop's general rubber goods division in Cambridge Street, Manchester. The matting is in a raised cube pattern to reduce the danger of slipping. Other advantages are its resilience, which will reduce the fatigue of standing; its absorption of noise; and its protection of the worker from chills.

GIVEN FULL SUPPORT from labour there could be a revival of the shipbuilding industry of this country, indicated Dr. Denis Rebbeck, deputy managing director of Harland & Wolff, Limited, when his firm launched from their Govan yard on April 21 the 12,000 tons d.w. motor-driven passenger and cargo vessel Triaster, for the British Phosphates Commissioners.

A NEW gas-operated system for bar annealing was opened by Arthur Balfour & Company, Limited, steelmakers, Sheffield, on May 5. The plant has been built at a cost of £40,000 on the site of a heating plant at Broughton Lane, and was opened by Mr. Jack Moore, 60-year-old foreman at the firm's Wicker Works. The heat-treatment works at the Wicker closed down on May 6.

A NEW £20,000 sports ground for William Jessop & Sons, Limited, steel manufacturers, Brightside Lane, Sheffield, is to be opened by Lady Docker in June. It covers eight-and-a-half acres at Green Lane, Ecclesfield, and more than £1,200 has been spent on machinery for the working of the grounds. The firm's sports club, which has 26 sections, is one of the largest in Sheffield.

THE SECRETARY OF STATE FOR SCOTLAND has just confirmed a £1,300,000 scheme by which the North of Scotland Hydro-Electric Board propose to develop the water power resources of Loch Glashan, near Lochgilphead, Argyll. The output of the new station, about 17,600,000 units a year, will help to meet a rapidly growing demand for electricity in the Kintyre and Knapdale areas.

RUBERY OWEN & COMPANY, LIMITED, Darlaston, staged a Safety Week exhibition with the title " Ten Years Progress of Safety " at their factory during the week beginning May 2. During the period represented by the exhibition, time lost through accidents at the works had been reduced from 147,000 hours a year to 47,000 and suggestions were being invited to reduce that figure still further.

VOKES EXHIBITION, which presents a comprehensive display of products of the Vokes Group of companies, this year returns to Glasgow, where on May 7 to 12 at the Grand Hotel, Charing Cross, the post-war series of private shows will be continued. Similar

News in Brief

displays have already been held in Manchester, Birmingham and London, and this year's floor space is seven times greater than that of the original Glasgow exhibition.

A NEW ENGINEERING FACTORY for Ralphs Engineering Company, Limited, Coalville, Leics, has been built at the junction of Parker Drive and Beaumont Leys Lane, Leicester, and a transfer of the works from Coalville to the new factory is being carried out. The company's headquarters are in Ross Walk, Leicester, but re-organization plans provide for the concentration of the whole business in the new works. The Coalville factory will be closed and will be merely used as a store.

AT THE British Instrument Industries Exhibition at Earls Court, from June 28 to July 9, George Kent Limited will be exhibiting a number of new industrial measuring and controlling instruments of which case-design and many internal parts have been standardized to BS recommendations. Amongst these will be systems for the automatic control of furnace temperature and combustion for various applications in the steel industry, in particular, a five-section unit-panel for soaking-pit control.

EIGHT COMPANIES are to form a new corporation with an authorized capital of £1,000,000 for the design and construction of nuclear power plant on a proposed site on Shields Road, Newcastle. C. A. Parsons, Limited, who are building the plant for the atomic power station at Calder Hall, Cumbrland, and who are one of the concerns in the new corporation, issued the invitation for the project. They have been joined by Head, Wrightson & Company, Limited, of Thornaby, and others will be named when the formation of the corporation is completed.

AMONG NEW EXHIBITS which are shortly to be added to Birmingham's Museum of Science and Industry, is a beam engine designed by Amos which has a 14-ft.-dia. flywheel; a locomotive which was built in 1864 in Birmingham; and the Napier Railton car in which John Cobb established a new world land speed record of over 400 m.p.h. Only one gift to the museum cannot be located there because of its size and that is the giant steam-blowing engine designed by Boulton & Watt which remains in the Netherton Ironworks of M. & W. Grazebrook, Limited.

THE BOARD OF TRADE announce that they invite tenders for the sale of 15,000 tons of electrolytic copper for pricing and delivery over five months beginning in June. Applications for tender forms should be made to the Board of Trade (Room 3166), Horse Guards Avenue, Whitehall, London, S.W.1. This quantity forms part of the unsold balance (about 28,000 tons) of the 45,000 tons of electrolytic copper, the impending sale of which was announced by the Board of Trade on April 13. The remaining 13,000 tons will be offered for sale later.

NOTTINGHAM UNIVERSITY SENATE has accepted in principle proposals for the introduction of chemical engineering in the university. It is planned to amalgamate fuel technology and chemical engineering in a single degree course with suitable options in the final year. The course will consist of an intermediate year of pure mathematics, physics and chemistry, followed by three post-intermediate years leading to an honours degree of Bachelor of Science. It is hoped that the Lady Trent Professor of Chemical Engineering may be appointed not later than October, 1957, and the new course may begin in October, 1958.

THE SECOND International Powder Metallurgy Congress, sponsored by Dr. Paul Schwarzkopf, president of the American Electro Metàl Corporation, Yonkers, N.Y., will take place in Reutte, Tyrol, Austria, from June 20 to June 23. Reutte was chosen again for the seat of this international seminar because Europe's largest powder metallurgy company, the Metallwerk Plansee, is located there. The topic will be "High Temperature and Corrosion-resistant Materials by Powder Metallurgy." So far, approximately 300 representatives from 17 nations have been registered as delegates, including over 30 scientists, industrialists and engineers from the United Kingdom.

ALDERMAN J. R. BALMER, Lord Mayor of Birmingham, opened, on May 3, the new Crown Works of Uddeholm, Limited, Northwood Street, Birmingham. The heat-treatment of Swedish steels is carried on at the works, which stand on a site taken over by the company a few years ago. A new modern factory to deal with the process has been erected. The company, of which the managing director is Mr. C. W. Robinson, who is also Vice-Consul for Sweden, is a subsidiary of the Swedish firm of the same name and was established in Birmingham in 1923. The parent company was founded nearly 300 years ago. The development of the Birmingham company led to the decision to undertake heat-treatment of the metal.

MR. A. W. TAYLOR, Tipton borough librarian, has a rivet which he believes came from the Aaron Manby, the world's first iron ship built in 1822 by a young Tipton engineer, Charles Manby. The ship was named after Charles' father, owner of the Horseley Ironworks, where the ship was designed and made. When assembled the Aaron Manby was 120 ft. long with a beam of 18 ft.; she was powered by a 30-h.p. steam engine. Her first cargo was one of iron and her first trip from London to Paris. The Tipton relic is unique as being all that remains of the Aaron Manby. The only other relic connected with it is a picture on the letterheading of the Manby firm, dated 1823, which is now in the South Kensington Science Museum.

THE FIRST section of a new factory for Hamworthy Engineering, Limited, on a 20-acre site at Fleets Corner, Poole, was opened by Mrs. Ingram Spencer, whose husband is chairman of the company, in the presence of 300 people including friends and customers of the firm and employees and their families. The guests afterwards toured the company's foundry at Newtown, where practically all the requirements of the pump and compressor, the oil-burning and the hydraulics divisions both in ferrous and non-ferrous castings are produced. Later, they went over the old factory at New Quay Road and saw as a special feature the lighting of the biggest oil-burner yet produced in Britain which has a maximum burning capacity of three tons of oil per hour and is going into BEA's power station at Marchwood.

WHEN Mr. Alec. W. Clark addressed the Rotherham and District Chamber of Commerce on his election as president for the third year in succession, he described the right to strike as now "unjustifiable and obsolete." He said that a significant point which emerged from the rail dispute was the problem of differential wage rates for the man of special skill or responsibility. He referred to the question of profits. "There is still too much loose talk about what profit should or should not be made," and then told how his own company bought a machine-tool in 1930 for £2,000, when the standard rate of tax was 4s. in the £. They had therefore to earn £2,500 to buy the tool. Last year the machine was replaced at a cost of £10,000, when the standard rate of tax was 9s., plus profits tax, and as a result the company had to earn about eight times the profit to purchase the same item.

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Personal

MR. J. DUMBLETON has retired after 60 years' service with Sidney Flavel & Company, Limited, Eagle Foundry, Leamington Spa.

MR. M. A. GRAHAM has been appointed sole technical representative in Northern Ireland for all the products of Rhodes, Brydon & Youatt, Limited, engineers, of Stockport (Ches).

MR. RALPH D. PARKER, of Copper Cliff, Ontario, has been elected vice-president, and MR. WALTER A. MCCADDEN, comptroller, of the International Nickel Company of Canada, Limited.

THE NEW PRESIDENT of the Derby Society of Engineers, elected at the annual meeting on April 25, is MR. LESLIE M. MCDONALD, who is works engineer at Leys Malleable Castings Company, Limited.

THE BOARD OF TRADE announces that bentonite can be imported from all countries without individual import licences from May 13. Imports from dollar sources have hitherto been subject to licensing control.

Councillor A. G. B. OWEN, chairman and joint managing director of the Rubery Owen group, was, on April 30, elected chairman of the Staffordshire County Council. Mr. Owen is a former mayor of Sutton Coldfield and chairman of Darlaston Urban District Council.

MR. S. W. MARTIN, acting chairman and managing director of the Staveley Iron & Chemical Company, Limited, Staveley, Derbyshire, and Mr. ERIC S. KEARSLEY, foundry sales manager, left on April 29 for Canada on a business trip. They will also visit the United States.

AT the annual meeting of the Derby Society of Engineers, Wing Commander J. M. AITON, chairman and managing director of Aiton & Company, Limited, pipe engineers, of Stores Road, Derby, was appointed chief patron in succession to MR. FRANCIS D. LEY, who has held the post for six years.

IT WAS ANNOUNCED on May 2—the eve of his 65th birthday—that MR. BENJAMIN F. FAIRLESS, president of the United States Steel Corporation since 1938, has retired, although he remains a director of the Corporation and will also continue to serve as a member of the finance committee.

MR. HORACE HOLROYDE, a foreman for 42 years with Edgar Allen & Company, Limited, Sheffield, was presented with a gold watch at the annual dinner of the Foremen's Association, which was held at the Arcade Restaurant, Sheffield. The presentation was made by Mr. W. H. HIGGINBOTHAN, chairman of the firm.

MR. C. F. B. HIPPISLEY has been appointed London sales manager to Brown, Lenox & Company, Limited. The appointment became effective on April 12, and Mr. Hippisley will operate from the company's London sales office at 157, Victoria Street, London, S.W.1. For the past 20 years, Mr. Hippisley has been with the Morgan Crucible Company, Limited.

MR. T. H. SUMMERSON, chairman and joint managing director of Summerson's Foundries, Limited, and of Thomas Summerson & Sons, Limited, railway plant manufacturers, etc., of Darlington, has been appointed a part-time member of the British Transport Commission. He is chairman of the commission's North-Eastern Area Board. Sir CECIL WEIR, who is shortly to relinquish his appointment as head of the United Kingdom delegation to the High Authority of the European Coal and Steel Community, and Mr. F. A. POPE have also been appointed part-time members of the Commission.

TO COMMEMORATE the diamond jubilee of the Birmingham College of Technology, on April 30, honorary associateship was conferred on several prominent industrialists. Sir LEONARD LORD, chairman and managing director of the British Motor Corporation, was among them as well as Sir FREDERICK HANDLEY PAGE, founder and managing director of the Handley Page Aircraft Company; Mr. A. B. WARING, chairman and managing director of Joseph Lucas Limited, and president of the Society of Motor Manufacturers and Traders; Sir RONALD WEEKS, chairman of Vickers Limited, and chairman of the National Advisory Council of Education in Industry and Commerce; and Mr. TOM WILLIAMSON, general secretary of the National Union of General and Municipal Workers.

Following the inauguration of the Metropolitan-Vickers X-ray department, which took over the business of M-V's subsidiary, Newton Victor, Limited, the branch offices of Newton Victor were amalgamated with the district offices of Metropolitan-Vickers. Mr. H. B. GOUGH was appointed sales manager of the X-ray department, and Mr. G. E. H. DEADMAN (Birmingham), Mr. R. B. GOUGH (London), Mr. A. R. HOLDSWORTH (Sheffield), Mr. D. MOODIE (Glasgow), Mr. H. A. RYDER (Cardiff), and Mr. J. TAYLOR (Manchester) were appointed superintendents, Newton Victor sales, in the districts stated. Mr. F. W. WATERTON had previously been appointed assistant chief engineer, X-ray department (Finchley works). Mr. A. K. NUTTALL remains chief engineer, X-ray department, and Mr. J. T. THORNHILL works manager (Motherwell and Finchley works).

Obituary

Mr. THOMAS JOHN HOWELL, who has died at the age of 86, was formerly accountant to the Glanmor Foundry Company, Limited, Llanelly.

The death is announced of Mr. R. J. PARKER, who was manager of the spares and repairs department of George Kent, Limited. He has been a member of the company since 1907.

The death occurred on April 23 of Mr. A. E. RALPH, who founded the firm of A. E. Ralph & Company, Limited, iron and steel merchants, etc., of Birmingham, of which he served as chairman and managing director.

MR. JOHN R. LEVERINGTON, of Tankersley, near Sheffield, who has died at the age of 73, had completed 60 years' service with Newton Chambers & Company, Limited, Thorncliffe Works, Chapeltown, Sheffield, when he retired last year.

MR. WALTER FREDERICK BISHOP, who died recently (a few days before his 67th birthday), entered the employment of W. T. Henley's Telegraph Works Company, Limited, in 1895, and after 30 years' service was appointed assistant general manager. In 1932 he became general manager and the following year was elected to the board.

Major JOHN STEPHEN THOMPSON, who died last month at the age of 79, was the son of the founder of John Thompson, Limited, engineers, boilermakers, etc., of Wolverhampton, and was formerly governing director of the company, retiring from the board last year. Major Thompson was a past-president of the Institution of Mechanical Engineers and High Sheriff of Staffordshire in 1938-39.

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Raw Material Markets

Iron and Steel

The blast furnaces maintain production at high levels, and with the new furnaces which are scheduled to come into operation during the year bigger outputs still may be expected. Deliveries of ore are good, and although the supply of suitable blast-furnace coke is not so assured, it is expected that adequate supplies will continue to be available for burdening the furnaces.

Since the turn of the year, three additional furnaces have come into blast, 99 in all producing the different grades of pig-iron utilized by the steelworks, foundries, and other trades. Of the total output the steelworks receive the greater proportion, representing over three quarters of available tonnages, while the balance consists mainly of hematite and foundry irons, although an appreciable tonnage of the former is also utilized by the steelworks.

With the present demand for castings a much larger tonnage of pig-iron could be taken up by the iron-foundries. All grades are short, and there is little prospect of the supply improving. The foundries are indenting for much larger tonnages than the furnaces can despatch, and mostly have to rely on day-to-day deliveries. Any interruption of deliveries slows production.

Most foundries receive plenty of fresh business to replace completed orders. The engineering and speciality foundries are very busy, and the majority of the jobbing and light foundries are able to obtain good outputs, although some of the latter are not so heavily committed as others.

The shortage of cast-iron scrap continues, and this necessitates the use of larger quantities of pig-iron.

There is little, if any, improvement in deliveries from home steelworks to the re-rollers and it will be some few weeks yet before the increased supplies which are expected from overseas materialize. Meanwhile, the re-rollers are continuing production under great difficulties, and find it impossible to keep abreast of their commitments.

Non-ferrous Metals

The big news last week, which, however, was not announced in Lusaka until late on Friday, was the producers' special price for copper for which all have been waiting. This has been nominated at £280 on a c.i.f. basis and compares with £304 at which copper closed on Friday afternoon. The equivalent in cents is 35, so that it is below the U.S. official producers' level. Guesswork had placed the R.S.T. "stability" price at somewhere between £280 and £290, so that the announcement will not cause undue surprise. This level is to be maintained for at least 30 days and may be longer. The concession is certainly a fairly generous one and shows that the producers are in earnest in their endeavour not only to stabilize the quotation but also to get the price down.

There was also an announcement by the Board of Trade that tenders are invited for the sale of 15,000 tons of electrolytic copper for pricing and delivery over five months beginning in June. This is part of 28,000 tons, which is the balance of 45,000 tons originally mentioned by the Government, the 17,000 tons having gone to the Rhodesian producers.

Markets last week were fairly steady, but copper lost ground, closing £5 10s. lower for cash and £7 down for three months. Tin closed lower at £710 and £713 10s., cash being down £3 10s. and three months £2. Zinc was steady and closed 5s. up for May and 10s. better for August. Lead, on the other hand, lost some ground, the close showing a loss of 15s. in first half May and of 10s. in first half August.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* May 5, £305 10s. to £306 10s.; May 6, £306 10s. to £307; May 9, £301 to £302; May 10, £303 to £305; May 11, £304 10s. to £305 10s.

Three Months: May 5, £291 10s. to £292; May 6, £293 to £293 10s.; May 9, £289 to £289 10s.; May 10, £290 to £291; May 11, £291 10s. to £292.

TIN, Standard—*Cash:* May 5, £710 10s. to £711; May 9, £708 10s. to £709; May 10, £714 to £715; May 11, £711 to £712; May 12, £711 to £712.

Three Months: May 5, £714 to £714 10s.; May 6, £712 to £712 10s.; May 9, £717 to £718; May 10, £713 10s. to £714 10s.; May 11, £714 to £714 10s.

LEAD—*First half May:* May 5, £103 to £103 5s.; May 6, £103 to £103 5s.; May 9, £102 10s. to £102 15s.; May 10, £102 7s. 6d. to £102 10s.; May 11, £102 5s. to £102 10s.

First half August: May 5, £103 to £103 5s.; May 6, £103 to £103 5s.; May 9, £102 15s. to £103; May 10, £102 10s. to £102 15s.; May 11, £102 10s. to £102 15s.

ZINC—*First half May:* May 5, £88 10s. to £88 15s.; May 6, £88 15s. to £89; May 9, £88 15s. to £89 5s.; May 10, £89 5s. to £89 10s.; May 11, £89 to £89 10s.

First half August: May 5, £87 10s. to £87 15s.; May 6, £87 15s. to £88; May 9, £87 10s. to £87 15s.; May 10, £88 to £88 5s.; May 11, £87 15s. to £88.

Cast-iron Scrap Prices Raised

Controlled prices of cast-iron scrap were raised in most areas on Monday, under an Order made by the Minister of Supply after consultation with the Iron and Steel Board. The increases are designed to encourage the movement of cast-iron scrap between areas of surplus and areas of shortage, and have been agreed with the British Iron and Steel Federation, the Joint Iron Council, and the National Federation of Scrap Iron, Steel, and Metal Merchants.

Copies of the Order—the Iron and Steel Scrap (Amendment No. 1) Order, 1955—are obtainable from the Stationery Office (6d.).

The only grades of steelmaking scrap affected are heavy and light cast iron. For delivery in Scotland, Northumberland and Durham, and Yorkshire heavy cast-iron scrap is raised by 10s. a ton and for South Staffs delivery by 15s. 9d. Light cast-iron scrap is increased for the following deliveries:—Scotland, 7s.; Northumberland, Durham, and Yorkshire North Riding, 10s.; West Riding of Yorkshire, 8s.; South Staffs, 15s. 9d.

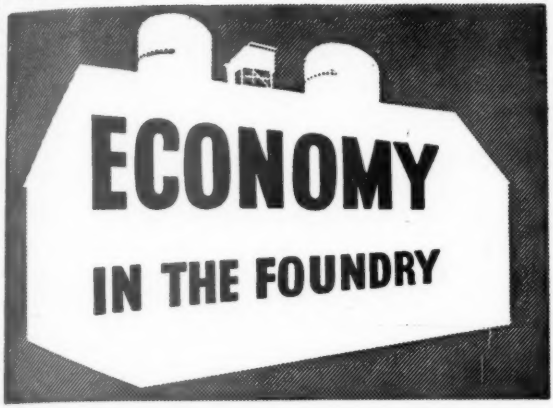
There is a new table of prices for foundry scrap. Short steel scrap is unchanged in price, and the controlled figures for burnt cast-iron scrap and firebars, cylinder blocks, and steel turnings also are unaltered, but there are increases for all other grades for most deliveries.

As examples of the increases, the following are the old and new rules in two of the scheduled areas—the Birmingham area and the County of London—for three classes of scrap:—

Heavy Machinery Scrap.—Birmingham, 170s. 9d. (previously 156s. 9d.); London, 148s. 9d. (no change).

Ordinary Heavy Cast Iron.—Birmingham, 165s. 9d. (149s. 6d.); London, 143s. 9d. (141s. 6d.).

Malleable Cast Iron. — Birmingham, 177s. 3d. (163s. 3d.); London, 177s. 3d. (163s. 3d.).



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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

May 11, 1955

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £15 12s. 0d.; Birmingham, £15 5s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £17 13s. 9d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £18 9s. 3d.

Scotch Iron.—No. 3 foundry, £18 2s. 3d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £20 4s. 0d.; South Zone, £20 6s. 6d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £21 1s. 6d.; South Zone, £21 4s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £18 2s. 6d.; Scotland (Scotch iron), £18 9s. 0d.; Sheffield, £19 7s. 6d.; Birmingham, £19 14s. 6d.; Wales (Welsh iron), £18 9s. 0d.

Basic Pig-iron.—£15 15s. 6d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots).—40/55 per cent., £40 15s. 0d., basis 45 per cent. Si, scale 15s. per unit; 70/84 per cent., £63 0s. 0d., basis 75 per cent. Si, scale 16s. per unit.

Ferro-vanadium.—50/60 per cent., 23s. 8d. to 25s. 0d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 11s. 0d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £161 0s. 0d. to £165 0s. 0d. per ton; 38/40 per cent., £258 0s. 0d. to £262 0s. 0d. per ton.

Ferro-tungsten.—80/85 per cent., 17s. 7d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 20s. 7d. per lb. of W.

Ferro-chrome (6-10 ton lots).—4/6 per cent. C. £82 0s. 0d. to £84 0s. 0d., basis 60 per cent. Cr, scale 25s. 0d. per unit; over 6 per cent. C, £80 0s. 0d. to £82 0s. 0d., basis 60 per cent. Cr, scale 24s. 0d. per unit; 2 per cent. C,* 1s. 10d. per lb. Cr; 1 per cent. C,* 1s. 11d. per lb. Cr; 0.15 per cent. C,* 1s. 11d. to 2s. 1d. per lb. Cr; 0.10 per cent. C,* 1s. 11d. to 2s. 2d. per lb. Cr; 0.06 per cent. C,* 2s. 3d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 6s. 7½d. to 7s. 1d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £225 0s. 0d. to £232 0s. 0d. per ton; 96/98 per cent., £259 0s. 0d. to £265 0s. 0d. per ton.

Ferro-columbium.—60/75 per cent., Nb + Ta, 52s. 6d. to 70s. 0d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £53 17s. 6d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £25 5s. 0d.; tested, 0.08 to 0.25 per cent. C, £26 5s. 0d.; hard (0.41 to 0.60 per cent. C), £27 10s. 0d.; silico-manganese, £34 10s. 0d.; free-cutting, £29 6s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £32 17s. 0d.; silico-manganese, £34 10s. 0d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 13s. 6d.; basic, hard, over 0.41 up to 0.60 per cent., C, £30 16s. 0d.; acid, up to 0.25 per cent. C, £33 15s. 0d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £31 1s. 6d.; boiler plates (N.-E. Coast), £33 11s. 6d.; floor plates (N.-E. Coast), £32 10s. 6d.; sectional material, N.-E. Coast, £29 4s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £31 19s. 6d.; flats, 5 in. wide and under, £31 19s. 6d.; hoop and strip, £33 1s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £34 5s. 0d.; black sheets (hand mill), 17/20 g., £43 13s. 6d.; galvanized corrugated sheets, 24 g., £55 4s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £54 7s. 9d.; nickel-chrome, £76 7s. 9d.; nickel-chrome-molybdenum, £86 8s. 6d.

NON-FERROUS METALS

Copper.—Cash, £304 10s. 0d. to £305 10s. 0d.; three months, £291 10s. 0d. to £292 0s. 0d.; settlement, £305 10s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 2s. 11½d. per lb.; rods, 341s. 3d. per cwt. basis; 20 s.w.g., 374s. 6d. per cwt.

Tin.—Cash, £711 0s. 0d. to £712 0s. 0d.; three months, £714 0s. 0d. to £714 10s. 0d.; settlement, £712 0s. 0d.

Lead (Refined Pig).—First half May, £102 5s. 0d. to £102 10s. 0d.; first half August, £102 10s. 0d. to £102 15s. 0d.

Zinc.—First half May, £89 0s. 0d. to £89 10s. 0d.; first half August, £87 15s. 0d. to £88 0s. 0d.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £120 0s. 0d.; rolled zinc (boiler plates), all English destinations, £117 15s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £103 0s. 0d.

Brass Tubes, etc.—Solid-drawn tubes, 2s. 4½d. per lb.; rods, drawn, 3s. 2⅜d.; sheets to 10 w.g., 312s. 6d. per cwt.; wire, 3s. 0d.; rolled metal, 298s. 3d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £199; B6 (85/15), —; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £255; HTB2 (38 tons), £268; HTB3 (48 tons), £277.

Gunmetal.—RCH, 3/4 per cent. tin, —; BS1400, LG2 (85/5/5/5), £273; LG3 (86/7/5/2), £281; G1 (88/10/2/½), £355; (88/10/2/1), £344.

Phosphor Bronze.—BS1400, PB1 (AID released), £375 per ton.

Phosphor Bronze Strip, etc.—Strip, 433s. 0d. per cwt.; sheets to 10 w.g., 456s. 6d. per cwt.; wire, 4s. 5½d. per lb.; rods, 3s. 10d.; tubes, 3s. 8½d.; chill cast bars: solids 3s. 11d., cored 4s. 0d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 9½d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 2¾d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 1¾d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 3d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £108 0s. 0d. Nickel, £519 0s. 0d. Aluminium, ingots, £163 0s. 0d.; aluminium bronze (BS1400), AB1, £334; AB2, £340. Solder, brazing, BS1845, 2s. 9d. lb.; granulated, 3s. 0d. lb.

* Average 68-70 per cent.